

PB-233 136

SPECIFIC ION MASS SPECTROMETRIC
DETECTION FOR GAS CHROMATOGRAPHIC
PESTICIDE ANALYSIS

Maynard B. Neher, et al

Battelle Columbus Laboratories

Prepared for:

Environmental Protection Agency

January 1974

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

SELECTED WATER RESOURCES ABSTRACTS INPUT TRANSACTION FORM		PB 233 136 W 14-08943
4.	Specific Ion Mass Spectrometric Detection for Gas Chromatographic Pesticide Analysis,	November 1973
7.	Maynard B. Neher and James R. Hoyland	10 EPA Project 16-8309-1
7.	Battelle-Columbus Laboratories	16ADN28
U.S. Environmental Research Laboratory		11. Grant R-800909
Environmental Protection Agency, Technology Series EPA-660/2-74-004, January 1974.		Period Covered: July 1, 1971 thru June 30, 1973
15.	report number, 33 p, 15 fig, 7 ref, 2 append. Computer programs have been developed for a PDP8/e controlling a Finnigan 1015 quadrupole mass spectrometer to monitor selected ions from components in a gas chromatographic effluent. The program is designed to monitor only a few ions (1 to 8) to enhance the sensitivity for the selected ions. Signal-to-noise levels of 10:1-30:1 have been obtained for 0.2 ng or less of four pesticides employing chemical ionization mass spectrometry and a digital smoothing routine. (EPA) ~~This report was submitted in fulfillment of Project Number 16ADN 28, Grant Number R 800909, by Battelle Memorial Institute under the sponsorship of the Environmental Protection Agency. Work was completed as of June 30, 1973~~	
17a	*Mass Spectrometry* *Gas Chromatography* *Pollutant Identification* Organic Compounds*	*Computer* programs, Data Processing* *Organic Pesticides* Monitoring, *Pesticides
17b	*Specific Ion Monitoring* GC/MS* Computer Control* Pesticide Mixture	Reproduced by NATIONAL TECHNICAL INFORMATION SERVICE U S Department of Commerce Springfield VA 22151
17c	05A	
Copy Available from GPO Sup Doc as EPA 660/2-74-004, \$6.55; microfiche from NTIS as PB-233 136 \$1.45		Send To: WATER RESOURCES SCIENTIFIC INFORMATION CENTER U S DEPARTMENT OF THE INTERIOR WASHINGTON, D C 20240
M. B. Neher		Battelle Memorial Institute

I

EPA-660/2-74-004
January 1974

SPECIFIC ION MASS SPECTROMETRIC
DETECTION FOR GAS CHROMATOGRAPHIC
PESTICIDE ANALYSIS

By

Maynard B. Neher and James R. Hoyland

Grant No. R-800909
Project 16ADN 28
Program Element 1B1027

Project Officer

Dr. John M. McGuire
Chromatography & Mass Spectrometry Section
Southeast Environmental Research Laboratory
Athens, Georgia 30601

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. Department of Commerce
Springfield VA 22151

Prepared for
OFFICE OF RESEARCH AND DEVELOPMENT
U. S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D. C. 20460

ABSTRACT

Computer programs have been developed for a PDP8/e controlling a Finnigan 1015 quadrupole mass spectrometer to monitor selected ions from components in a gas chromatographic effluent. The program is designed to monitor only a few ions (1 to 8) to enhance the sensitivity for the selected ions. Signal-to-noise levels of 10:1-30:1 have been obtained for 0.2 ng or less of four pesticides employing chemical ionization mass spectrometry and a digital smoothing routine.

This report was submitted in fulfillment of Project Number 16ADN 28, Grant Number R-800909, by Battelle Memorial Institute under the sponsorship of the Environmental Protection Agency. Work was completed as of June 30, 1973.

CONTENTS

<u>Sections</u>	<u>Page</u>
I CONCLUSIONS	1
II RECOMMENDATIONS	2
III INTRODUCTION	3
IV COMPUTER PROGRAM DEVELOPMENT	8
V SYSTEM PERFORMANCE	29
VI REFERENCES	35
VII APPENDICES	36

FIGURES

<u>No.</u>		<u>Page</u>
1	General Program Flow Chart	9
2	Flow Chart for Program Initialization	12
3	Flow Chart for Calibration-File-Packing Subroutine	13
4	Flow Chart for Subroutine for Imputting Masses, Integration Times, Total Run Time and Number of Points to Sum	14
5	Flow Chart for Rod-Voltage-Setting Subroutine	15
6	Flow Chart for Mass-Spectrometer-Scan Routine	17
7	Flow Chart for On-Line Data Plotting Routine	19
8	Flow Chart for Data-Buffer-Processing Routines	21
9	Flow Chart for Mass-Storage-Data-Recording Routine	22
10	Flow Chart for Smoothing Routine	23
11	Flow Chart for Keyboard Monitor	25
12	Flow Chart for Off-Line Plotting Program	27
13	Electron Impact and Chemical Ionization Mass Spectra of p, p'-DDT	31
14	SIM Plots of Single Pesticides	32
15	SIM Plots of Pesticide Mixture	34

ACKNOWLEDGEMENTS

Assistance of personnel of the Southeast Environmental Research Laboratory is gratefully acknowledged. Their experimental evaluation was of great help in debugging the computer program.

Dr. Rodger Foltz of the Columbus Laboratory of Battelle Memorial Institute aided in the development of design parameters for the computer programs.

SECTION I

CONCLUSIONS

Two computer programs have been developed for selected ion monitoring of gas chromatographic effluent components with a Finnigan 1015 quadrupole mass spectrometer equipped with a System 150 data system. The programs are designed for a PDP8/e (or PDP-8/f or PDP8/m) computer equipped with the extended arithmetic element (EAE). With these programs, signal-to-noise ratios of 10:1 to 30:1 have been obtained for 0.2 ng or less of four pesticides employing chemical ionization mass spectrometry and a digital smoothing routine. Programs are also available with EAE simulator routines for computers without EAE. These programs have been debugged and are ready for general distribution.

SECTION II
RECOMMENDATIONS

The debugged Selected Ion Monitoring programs should be made available to users of Finnigan quadrupole mass spectrometers equipped with System 150 data systems.

SECTION III

INTRODUCTION

The goal of this project was the development of a practical system for application of "Selected Ion Monitoring" to gas chromatographic analysis of pesticides.

Selected Ion Monitoring (SIM) is the technique of monitoring one or only a few ions from a mass spectrum rather than acquiring complete mass spectra. The technique has been demonstrated magnetic deflection mass spectrometers.⁽¹⁻⁴⁾ However, magnetic deflection instruments have one serious drawback for development of this technique to its ultimate; it is difficult to change from one mass to another quickly by changing the magnetic field strength because of the hysteresis of magnet systems. The LKB mass spectrometer, for example, employs a change of the accelerating voltage to focus on different masses. This limits the masses that can be monitored to a range of about 10 percent of the mass. If a larger mass range is covered, there are significant differences in the sensitivity to the various masses.

The quadrupole mass spectrometer is well suited to the peak-monitoring technique because all that is needed to change from one mass to another is to change the voltage on the quadrupole rods. The Finnigan mass spectrometer in combination with a computer data system such as the System 150 provides an ideal system for development of a Selected Ion Monitoring mass spectrometric technique.

Chemical ionization mass spectrometry is also ideally suited to the SIM technique. It appears that chemical ionization gives higher sensitivity than electron impact ionization. In addition, most compounds produce

fewer ions with significant intensity under chemical ionization conditions than under electron impact ionization conditions. Thus, the simpler spectra give less chance for ambiguous identifications with chemical ionization mass spectrometry.

SECTION IV

The System 150 provides standard programs for data acquisition and display. These programs are ideal for gas chromatographic data; they provide output of real-time and reconstructed gas chromatograms as well as mass spectra plots. However, the standard programs are designed for discrete mass spectra. If the operator elects to monitor only one ion, an entire block of data is recorded for each point, so that a large amount of file storage room is required.

For electronic signals with random noise, the signal-to-noise ratio increases as the square root of the observation time,

$$S/N = k\sqrt{Vt}.$$

For example, consider the comparison of an ion in a standard mass spectrum (3 sec. scan, 300 amu) with monitoring of a single peak (100 msec integration periods) for a standard mass spectrum 10 msec is spent on each peak, but 2.3 msec is required for settling time between masses, so 7.7 msec is the actual integration time. For the SIM technique, the integration time is 97.7 percent of the total time. Hence the expected signal-to-noise ratio improvement is given by:

$$S/N = \sqrt{.977 \times 3 \times 1000 / 7.7} = 19.5$$

The standard System 150 routines are not well suited for the SIM technique. For disk systems, the large amount of storage space is not a major obstacle, although only a few runs can be made before a disk will be full. For a DECTape system however, it is a major problem. It is not unusual for a gas chromatographic run to last 30 minutes, and for 1 sec integration times, 1800 spectra would be acquired; a DECTape will only hold at most about 1200 spectra (1472 blocks, but about 250 are required for system programs).

Baseline noise due to column bleed is a significant problem in gas chromatography, particularly in programmed temperature operation. It is usually corrected by dual column operation, bucking one against the other (i.e. by baseline subtraction). For combined gc/ms, a single column technique, this solution is not feasible. The System 150 programs provide a background subtraction capability for display of individual spectra, but have no way of suppression or subtraction of the baseline in reconstructed gas chromatograms. Since baseline suppression is necessary for maximum sensitivity this is a serious shortcoming of the standard System 150 programs.

Further, the ions of interest in a gc/ms run change with the progress of the run. The standard System 150 programs provide the capability of monitoring only a few ions, but monitors the same set of ions during the entire run. Since all ions of interest must be monitored all the time, this reduces the percentage of the time that can be spent on each, thus reducing the theoretical signal-to-noise enhancement of the SIM technique.

SECTION V

COMPUTER PROGRAM DEVELOPMENT

This project was devoted to development and evaluation of computer programs for implementing compound specific mass spectrometric detection on a Finnigan mass spectrometer equipped with a System Industries System 150 mass spectrometer control system. This report describes the overall programs, flow charts for the overall program, and more detailed flow charts for the individual segments. Program assembly listings are given in the Appendices.

The programs will operate with either disk or tape-based systems. Of course, the disk system provides room for more data storage. However, two DECTapes provide ample storage for any normal run. Two programs have been written, one for data acquisition (including on-line presentation of the first mass specified, using the Houston digital plotter) and one to plot all data points to the same scale. These programs are discussed below. The programs are designed to operate on a 4K PDP8/e computer equipped with the KE8E extended arithmetic element (EAE). However, since the EAE is not required for the System 150, versions that do not require the EAE have been written for both programs. The non-EAE data acquisition program is not noticeably slower than the EAE version for most applications. However, the non-EAE off-line plotting program is noticeably slower.

Data Acquisition Program

The program provides for monitoring from one to eight different masses. The integration time for each mass can be specified separately to avoid saturation for strong peaks while providing required sensitivity for weak peaks. For improved signal-to-noise ratio on weak peaks without danger

of saturating strong peaks, a selectable number of consecutive points for each mass can be added together and stored as a double precision value. The value for the first specified mass is plotted to give a real-time chromatogram.

This program is designed to be called as a USER program on System 150, and uses standard System 150 mass-storage read, write, and file handling routines, standard teletype and plotter routines. These subroutines are the property of System Industries and therefore not discussed or listed in this report. The multiply and divide routines that are based on the EAE option are included in the program listing, but are not flow charted or discussed.

The program consists of five basic segments:

1. Initialization,
2. Mass Spectrometer Scan Control,
3. Data Recording,
4. On-Line Data Presentation, and
5. Keyboard Monitor.

A number of smaller subroutines are used to implement input, output and other functions. The overall flow of the program is shown in Figure 1. The individual program segments are described in the following sections.

Initialization. The initialization phase of the program sets all initial parameters for data acquisition. These are:

1. Calibration File Name. This program assumes the presence of a standard system calibration file.
2. Masses to be Monitored. From 1 to 8 can be specified, decimal fractions permitted.

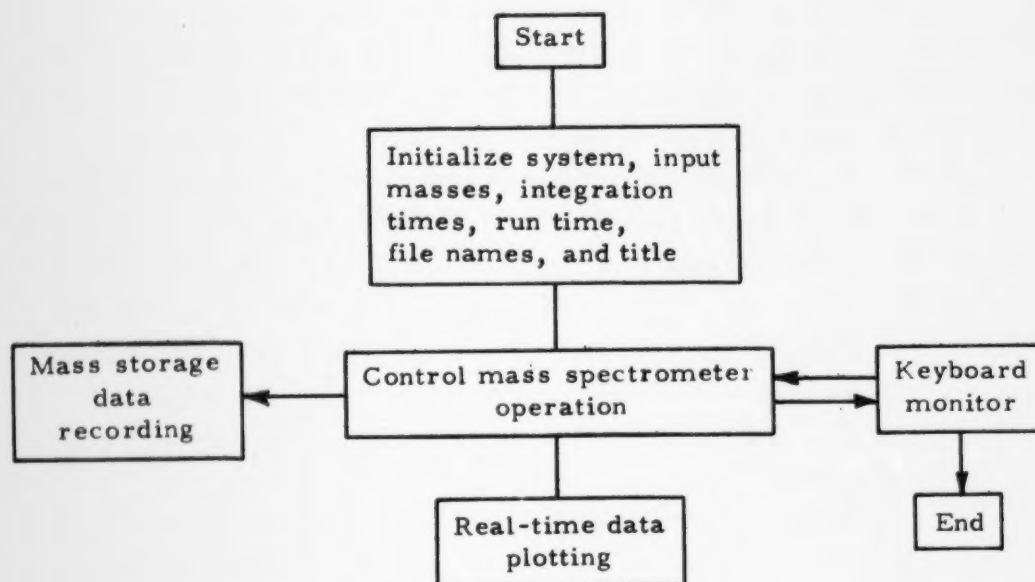


FIGURE 1. GENERAL PROGRAM FLOW CHART

3. Integration Time. The integration time is specified, in milliseconds (max of 4096). As many integration times can be entered as masses. However, if fewer integration times are entered than masses, the last time entered is used for the rest of the masses. (All masses can be monitored at the same integration time by entering only a single integration time).
4. Number of Sets of Masses. To permit rapid change of conditions, up to three sets of masses and integration times can be specified at the start of the run.
5. Number of Points to Scan For Each Mass. The specified number of values for each mass are summed and entered as a single value in the file of recorded data. This permits the equivalent of long integration times and frequent data sampling so that real data fluctuations are not missed.
6. Title of Run. Room exists in the record for a descriptive title of up to 40 alphanumeric characters.
7. Maximum Time of the Run in Minutes. When the specified time has elapsed, the run is terminated automatically. However, the run can be terminated earlier if desired by entering E(CR) on the teletype. Control-L (depressing both the control key and L) aborts the run, i.e., terminates it without entering the file in the system directory.
8. Data File Name. This is the name (six characters or less) by which the file is catalogued on the system device.

In the initialization program, the calibration file data are packed into the proper format to set rod voltages, and the rod voltage settings are calculated for each set of masses entered. A linear interpolation is used for the calculation: $V_c = V_1 + (M_c - M_1) \times (V_2 - V_1) / (M_2 - M_1)$ where c is the

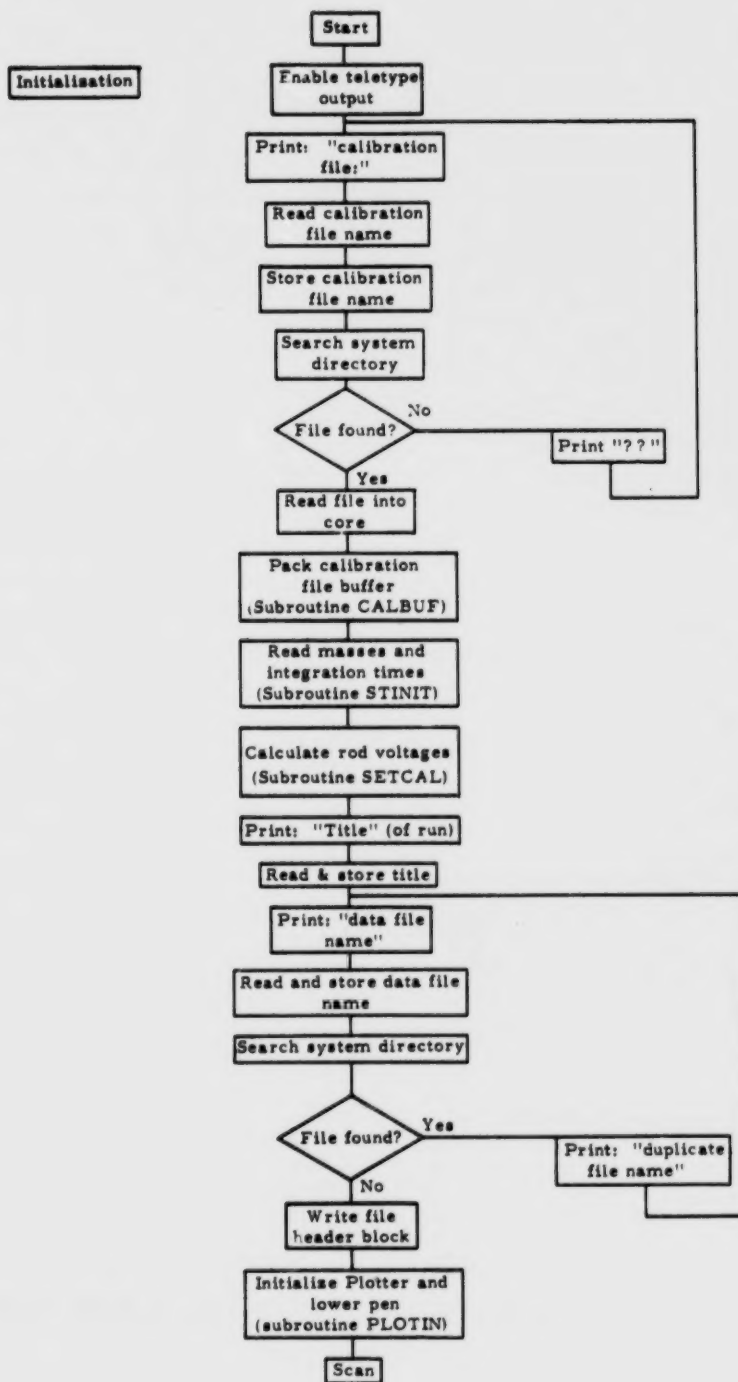


FIGURE 2. FLOW CHART FOR PROGRAM INITIALIZATION

CALBUF

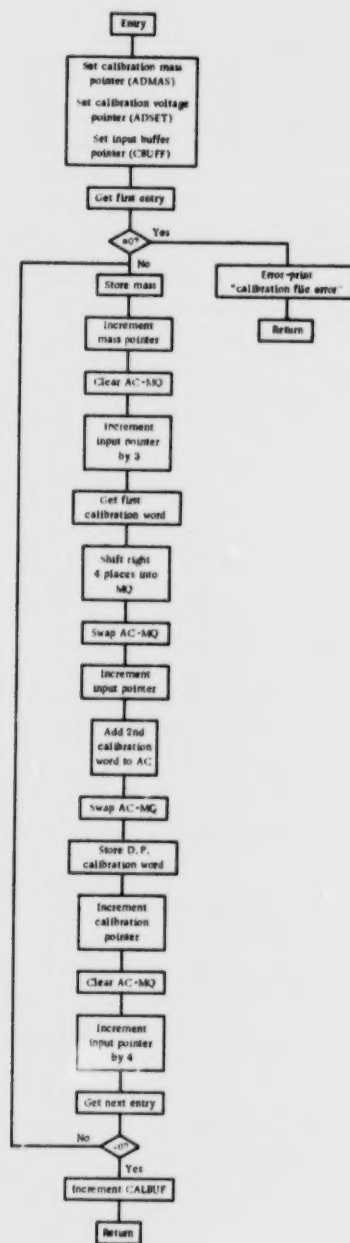


FIGURE 3. FLOW CHART FOR CALIBRATION-FILE-PACKING SUBROUTINE

STINT

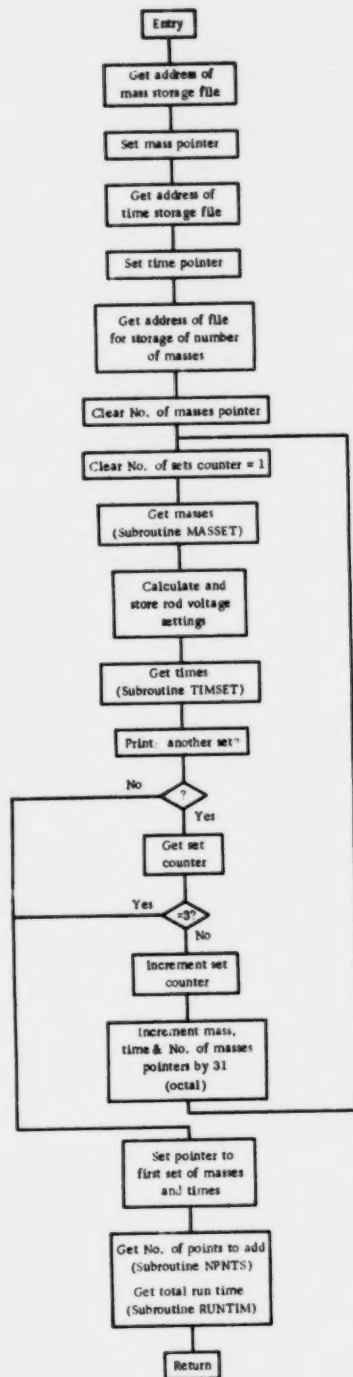


FIGURE 4. FLOW CHART OF SUBROUTINE FOR INPUTTING MASSES, INTEGRATION TIMES, TOTAL RUN TIME AND NUMBER OF POINTS TO SUM

point being calculated, and 1 and 2 are the mass/voltage points bracketing the point being calculated. If a mass that falls outside the range of the calibration file is entered, an error message is given, and the program waits for an acceptable set of masses.

A flow chart for the initialization program is given in Figure 2. Flow charts for subroutines used during initialization are given in Figures 3-5.

Mass Spectrometer Scan Control. The mass spectrometer scan is controlled by the computer using the normal mass spectrometer interface and controls. However, to optimize data handling and storage, the selected masses are monitored sequentially. The integration time for each peak must be selected such that the integrator does not saturate in the time selected. To avoid storing many small numbers, a number of sets of masses are scanned and the intensities for each summed using double precision addition.

A keyboard monitor allows the operator to change acquisition parameters during a run. If a change is requested, a marker is inserted in the mass storage record, and a new header block is written showing the new parameters before data recording is reinitiated. A flow chart for the scan control is shown in Figure 6.

On-Line Data Presentation. The data acquisition program provides for on-line plotting of the intensity of the first mass monitored. (Because the plotter is relatively slow, there is not time to plot all the peaks in real time without placing rather severe restrictions on the combination of parameters for data acquisition). The first mass in the list is the one that is plotted; however, the entries do not need to be in increasing mass order, so any mass can be plotted in real time. A flow chart for the on-line data presentation portion of the program is given in Figure 7.

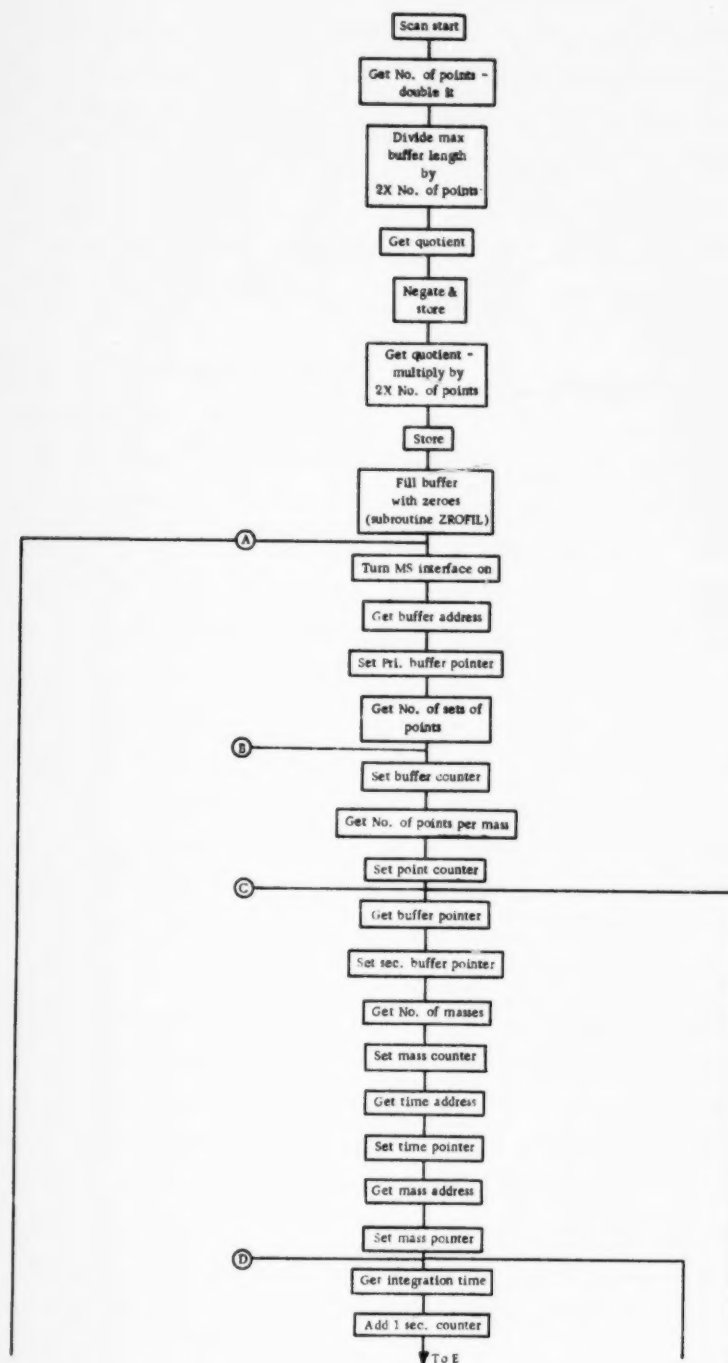


FIGURE 6. FLOW CHART FOR MASS-SPECTROMETER-SCAN ROUTINE

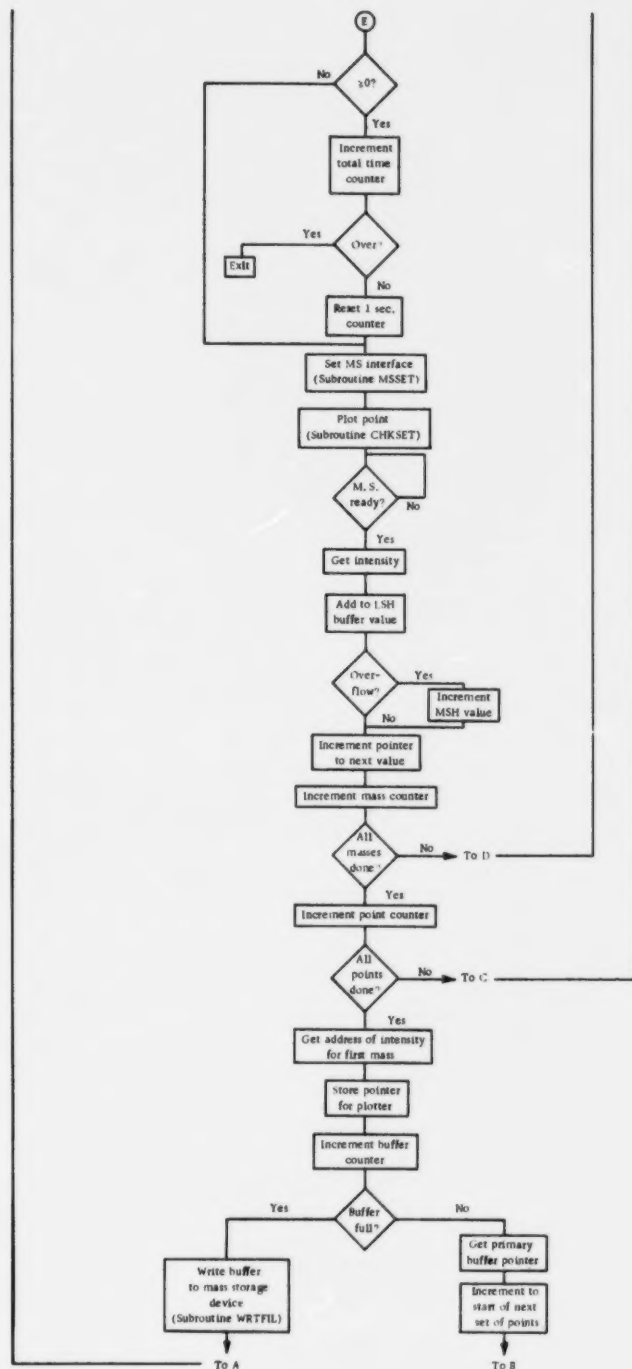


FIGURE 6. (continued) FLOW CHART FOR MASS-SPECTROMETER-SCAN ROUTINE

CHKSET
On-line data
plotting routine

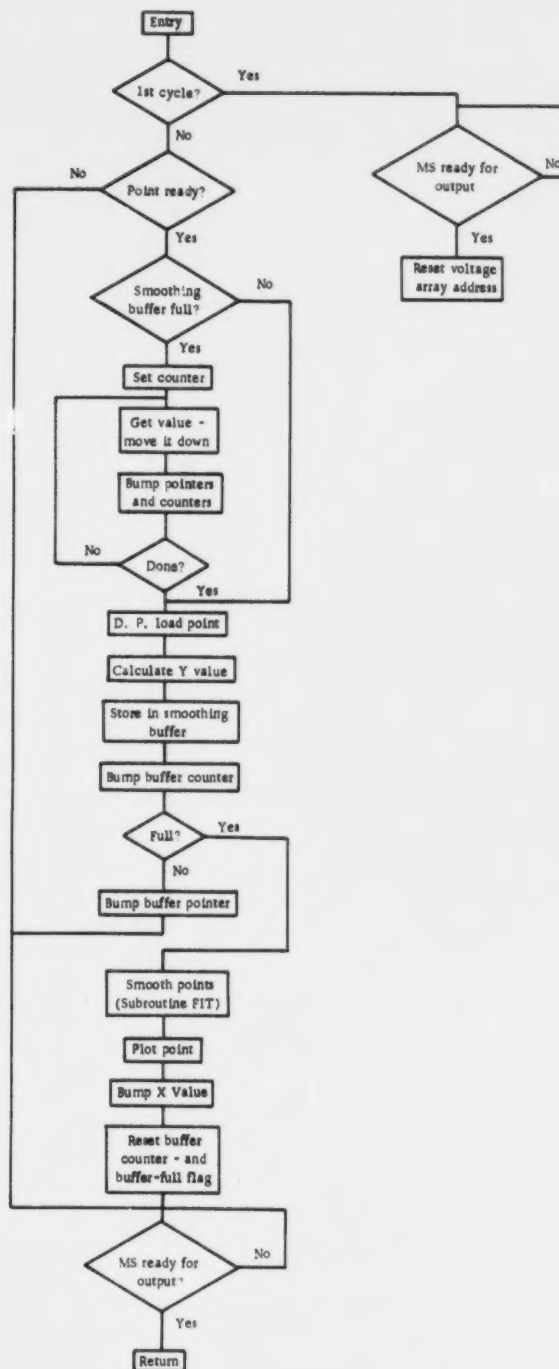


FIGURE 7. FLOW CHART FOR ON-LINE DATA PLOTTING ROUTINE

The initial program version plotted data on line as discrete points. Data thus presented was quite noisy. To decrease the noise level, a least-squares smoothing routine was added to the program. This routine uses the technique of Savitzky and Golay,⁽⁵⁾ in which smoothing is obtained by multiplying successive values by a set of smoothing factors, and dividing the sum of the products by a normalizing factor. A flow chart for this smoothing routine is shown in Figure 8.

Data Processing and Recording. The program uses one core page to record the title of the run and the data acquisition parameters. At the start of the run, this page is written onto the mass storage device as a header block. Five core pages of memory are used as a buffer for recording data. When the buffer is full, the data are written on the mass storage device, the buffer is filled with zeros, and data are then entered starting over at the beginning of the buffer. A flow chart for the data processing and recording routine is shown in Figure 9. (The program is independent of the mass storage device and will work on either disk or tape systems). The program checks to see that there is room at the end of the buffer for an inter-buffer flag. If there is enough room when a change of data recording parameters is signalled by the keyboard interrupt routine, a two-word inter-buffer record mark (7070 0000) is entered in the buffer. The buffer is then written on the mass storage device, and a new header block is recorded to indicate data acquisition parameters. If there is not enough room, the inter-buffer record is started at the beginning of the next block, so that the end-of-record flag will always be at the location for the start of a data set. When the run is terminated, a two-word end-of-file record mark (7171 0000) is entered in the buffer, the buffer is written out on the mass storage device, and the file is closed and catalogued in the system directory.

Subroutine
FIT

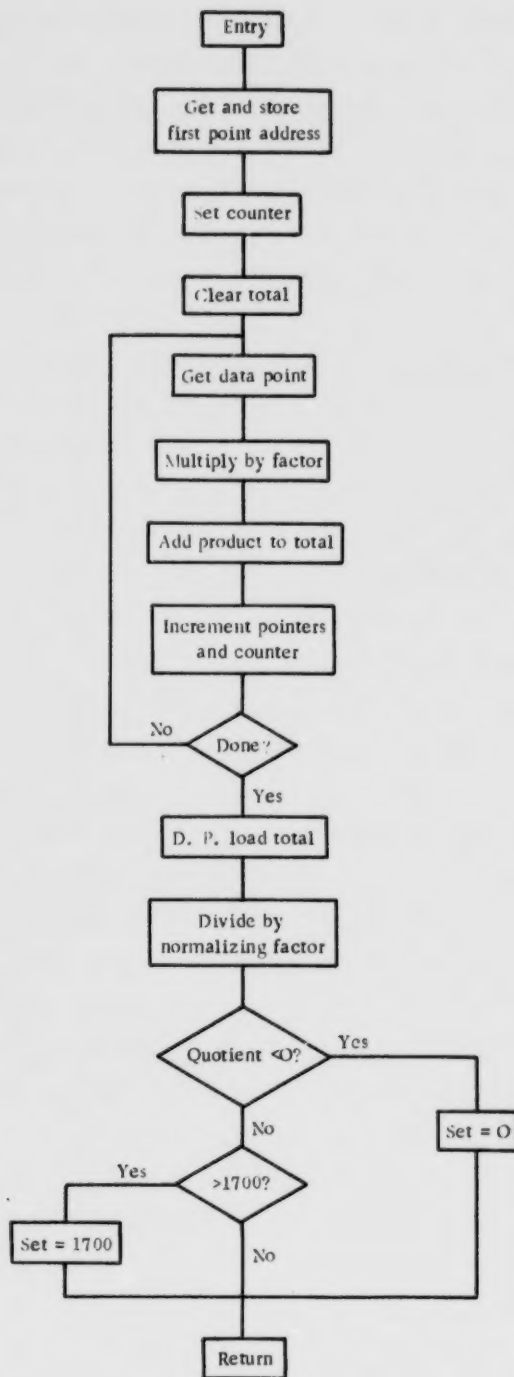


FIGURE 8. FLOW CHART FOR SMOOTHING ROUTINE

Flow charts for these routines are shown in Figure 9 and 10.

Keyboard Monitor. A keyboard monitor allows the operator to change parameters during data acquisition. The allowed commands are:

1. E(CR): End run, insert E-O-F and catalog file
2. Sn(CR): Change to set of masses n where $n = 1, 2, \text{ or } 3$
3. Nn(CR): Change number of points to n
4. Fn(CR): Change scale factor to n
5. Tn₁,n₂,---ni(CR): Change integration times to n₁,n₂--n₁
6. Control-L: Abort, do not catalog file

A flow chart for the keyboard monitor is shown in Figure 11.

Plotting Program

Since the on-line data acquisition program can plot only one mass from each set, an off-line program plots all data points. This program scans the entire data file prepared by the data acquisition program and determines the proper scale factor to keep the entire plot on scale. The minimum value is considered to be baseline and subtracted from all values for baseline suppression. It then makes a second pass through the data and plots each mass sequentially in the order data were acquired. Two output options are provided to the operator. After each mass is plotted, the prompt "CHANGE PEN " is printed by the teletype. If the operator wishes to overlay the plots using different ink colors, he should change the plotter pen and press the RETURN key. If he does not wish to overlay the plots, depressing any key other than RETURN advances the plotter chart about three inches and plot the next point. A flow chart of the program is shown in Figure 12.

ENDCHK

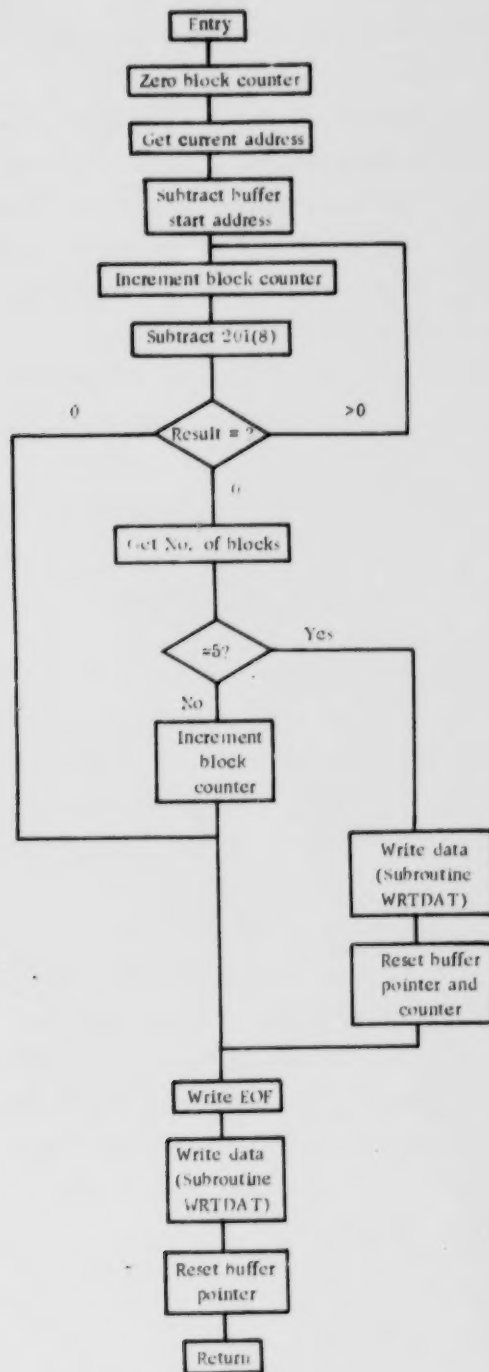


FIGURE 9. FLOW CHART FOR DATA-BUFFER-PROCESSING ROUTINE

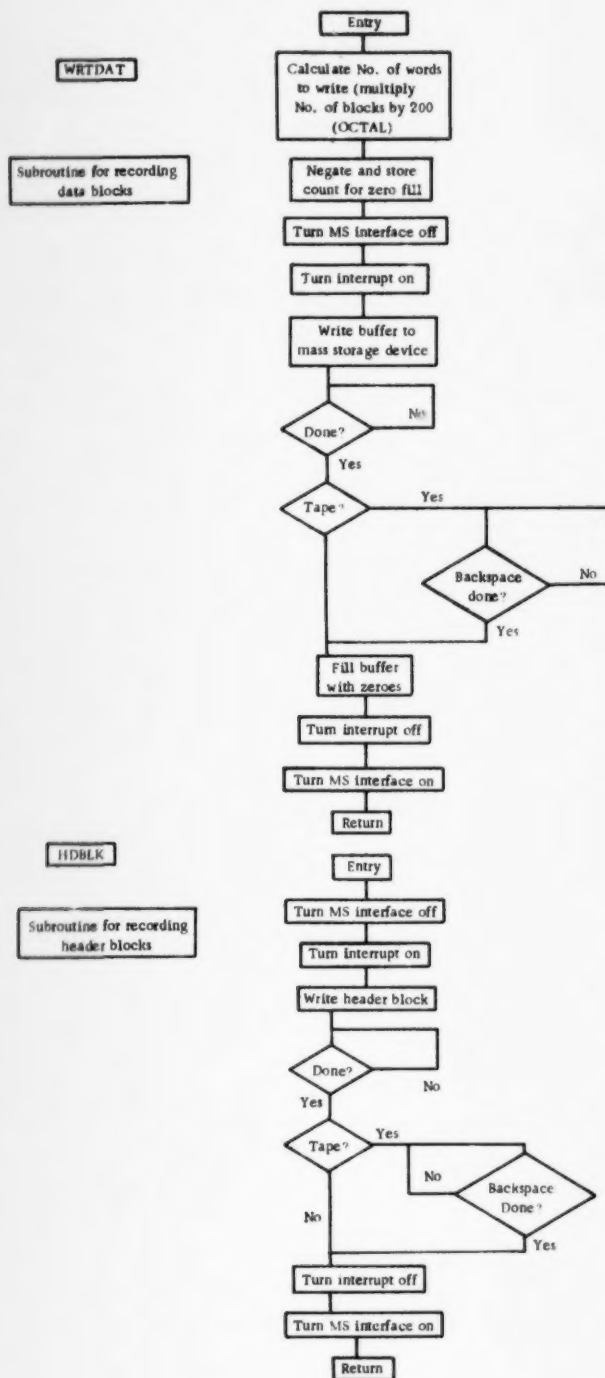


FIGURE 10. FLOW CHART FOR MASS-STORAGE-DATA-RECORDING ROUTINE

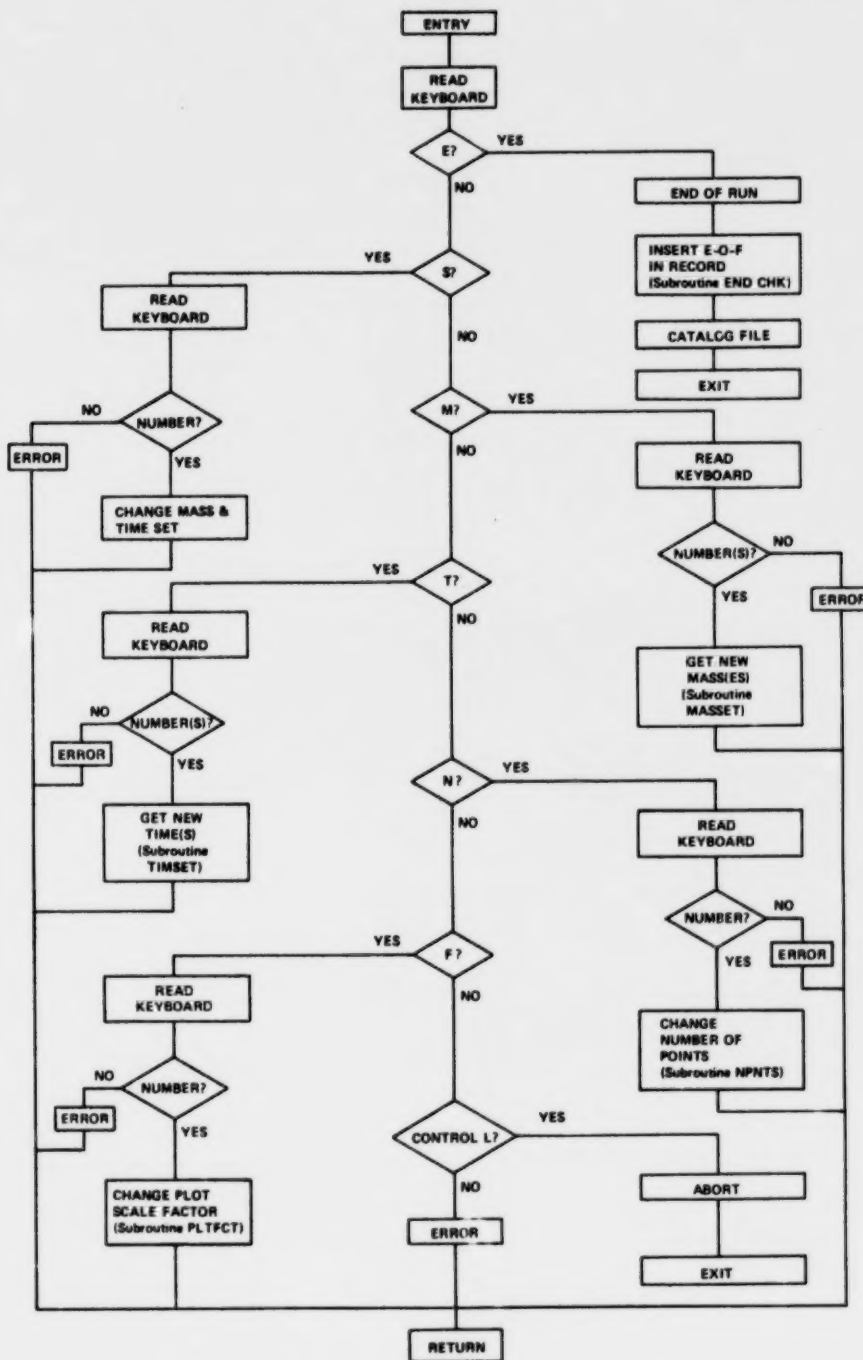


FIGURE 11. FLOW CHART FOR KEYBOARD MONITOR

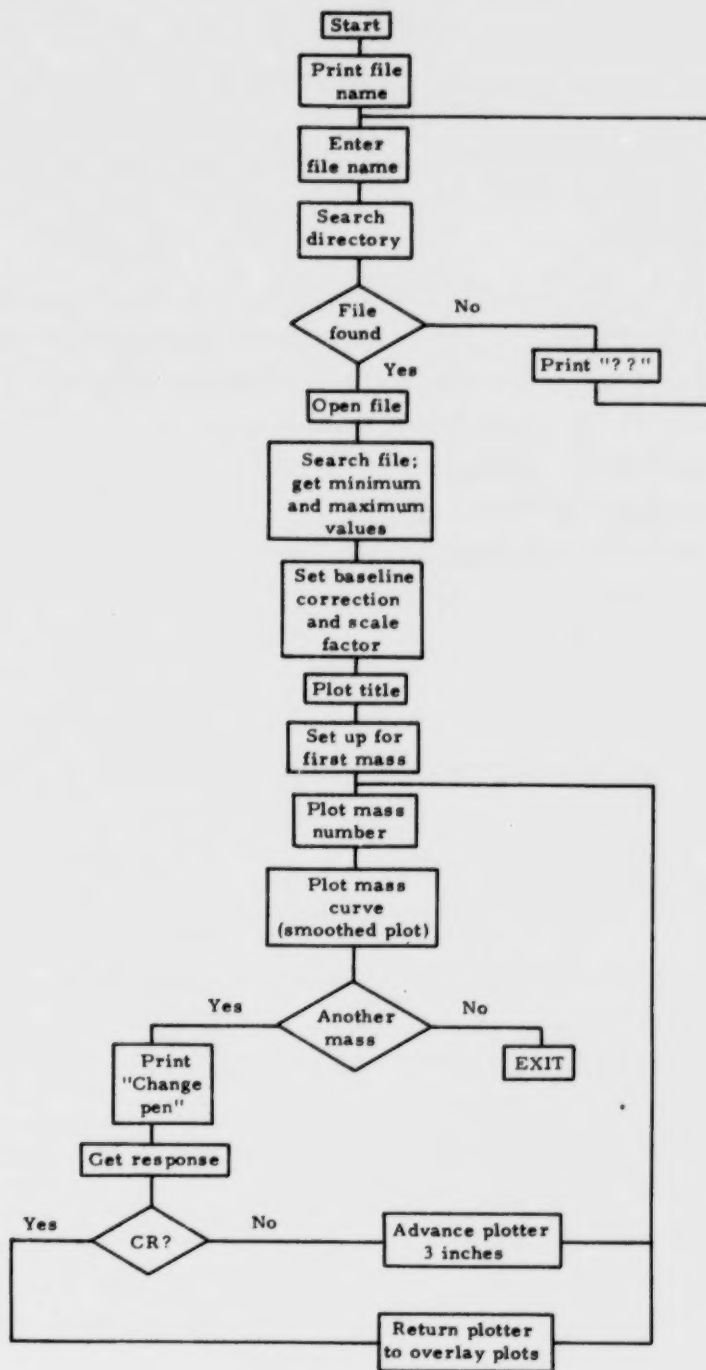


FIGURE 12. FLOW CHART FOR OFF-LINE PLOTTING PROGRAM

SECTION VI
SYSTEM PERFORMANCE

This section describes system operation and presents results obtained in this laboratory.

The SIM programs are called as USER programs on the System 150. A typical dialogue for a SIM data acquisition follows with operator responses underlined: (Each response is followed by a carriage return).

```
SYSTEM 150 IS ON SELECT MODE: USER  
LOAD FILE: SIMSCN  
CALIBRATION FILE: CAL-H  
MASS(ES): 243,209,279,292  
INTEGRA. TIME: 100  
ANOTHER SET?N  
NO. POINTS: 5  
RUN TIME: 30  
TITLE: GC-MS(CI-CH4) OF PESTICIDE MIXTURE  
SCALE FACTOR: 50  
DATA FILE NAME: N-1  
DATA
```

A sample of the plotting program dialogue is given below:

```
SYSTEM 150 IS ON SELECT MODE: USER  
LOAD FILE: SIMPLT  
FILE? N-1  
CHANGE PEN (CR)  
CHANGE PEN (CR)  
CHANGE PEN (CR)  
CHANGE PEN (CR)
```

The SIM technique is especially well-suited to analysis of very small quantities of known materials. Since the analysis is based on only a few ions, sensitivity is gained at the expense of the specificity of a complete mass spectrum. However, since it is generally intended for use in gc/ms, retention times provide additional confirmation of identity. Chemical ionization (CI) mass spectrometry is especially suitable for SIM because it is generally more sensitive than electron impact (EI) mass spectrometry and because CI spectra usually show less fragmentation than EI spectra. Accordingly, the development work on this project has been done with CI mass spectrometry. Four pesticides have been studied in the evaluation of SIM.

The EI and CI (CH_4) base peaks for these pesticides are tabulated below:

<u>Pesticide</u>	<u>M/E</u>	
	EI	CI
DDT	235	243
DDD	235	209
Dieldrin	79	279 (243 is 50% of 279)
Parathion	292	292

The spectra of the chlorinated pesticides show significant fragmentation under CI conditions, but better sensitivity is obtained with CI than EI conditions. EI and CI spectra for p,p'-DDT are shown in Figure 13. Figure 14 shows SIM plots for CI gc/ms of the four pesticides, 0.04 ng of DDT, 0.1 ng of parathion, 0.2 ng of dieldrin, and 0.2 ng of DDD. Signal-to-noise levels for these chromatograms have not been determined accurately but are approximately:

<u>Pesticide</u>	<u>S/N</u>
DDT	15:1
Dieldrin	10:1
DDD	12:1
Parathion	30:1

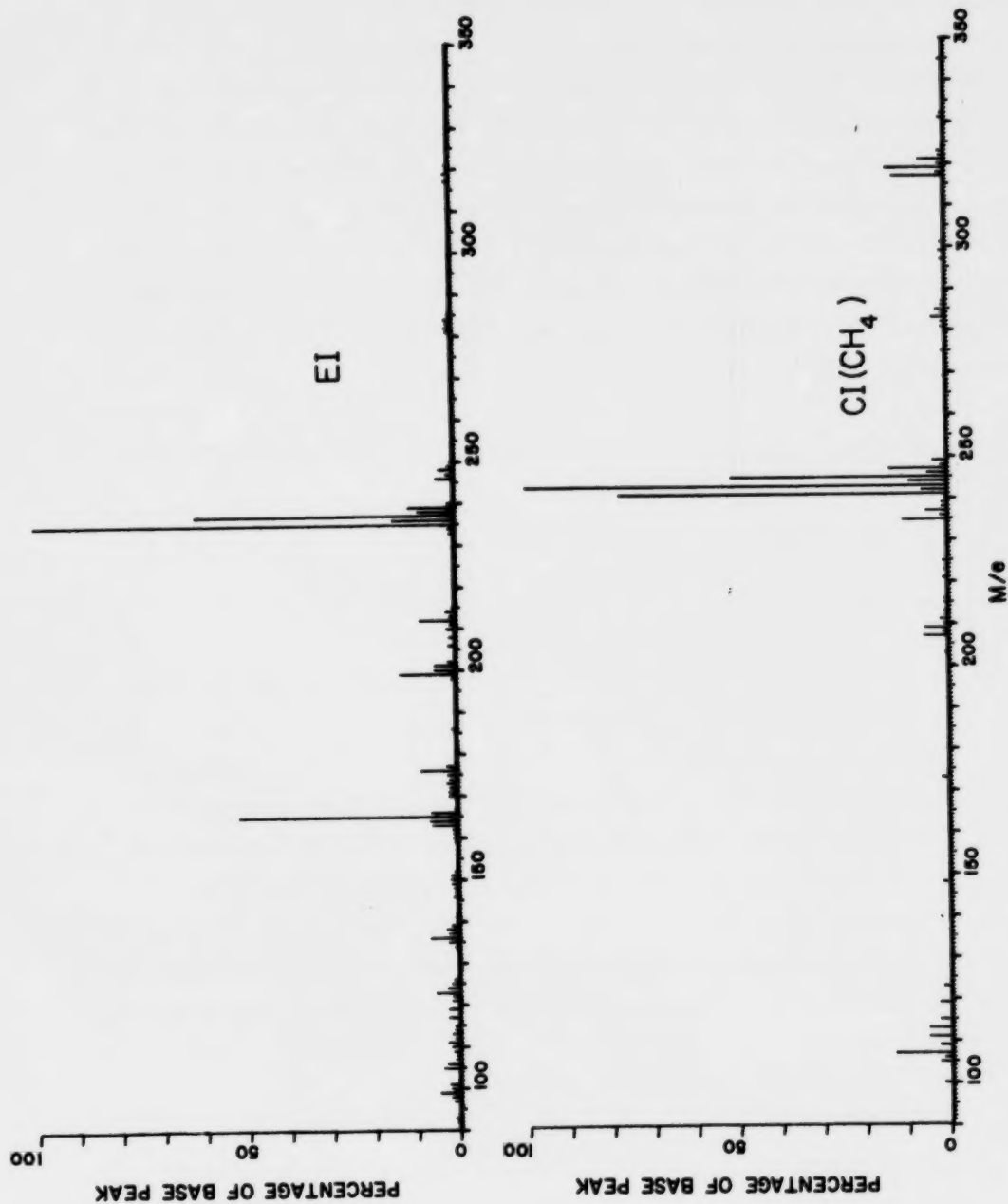


FIGURE 13. ELECTRON IMPACT AND CHEMICAL IONIZATION
MASS SPECTRA OF DDT

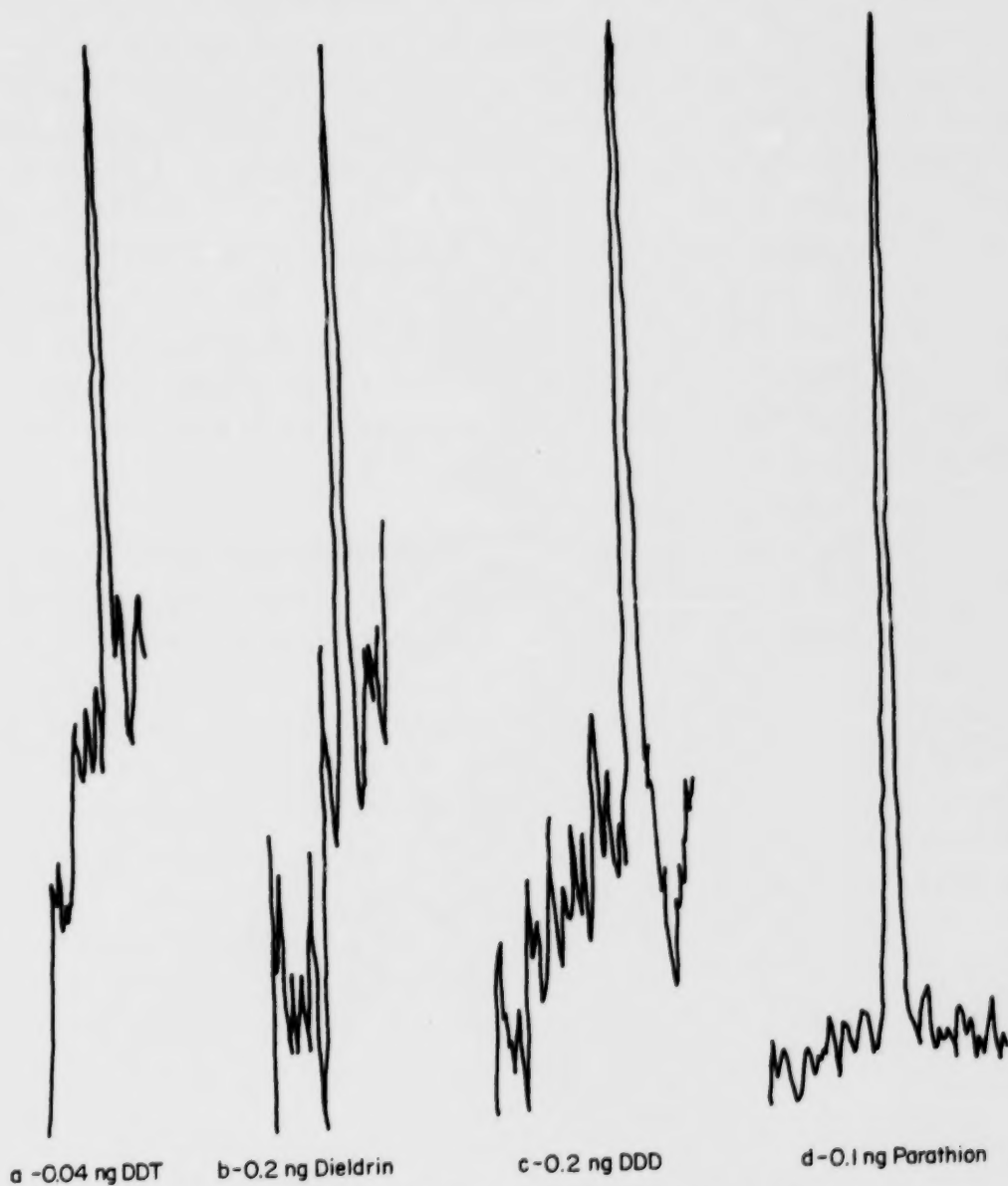


FIGURE 14. SIM PLOTS FOR CI GC/MS OF PESTICIDES
Carrier Gas: Methane 30 ml/min
Column Temperature: 175-250° C @ 10° C/min
Column: 6 ft. x 2 mm glass, 3 percent
OV-17 on Gas-Chrom. Q

Using methane CI gc/ms the best results so far have been obtained with Parathion and DDT. The limit of detectability for DDT is about .01 ng (10 pico grams) and about 0.002 ng (2 picograms) for Parathion. Precise limits of detectability have not been determined for either. For electron impact gc/ms the detectability limits are higher.

Figure 15 shows a CI gc/ms SIM plot for a mixture of 1 ng each of DDT, DDD, Parathion, and Dieldrin. The real time plot of m/e 243 shows two peaks. The first peak is for Dieldrin and is about 30 percent of the second peak (DDT). The reconstructed plot shows the relative retention of the four pesticides. The plot also indicates that DDD gives the highest response and Dieldrin, the lowest.

The SIM technique has also been applied to drug analyses using methane CI. Clarke and Foltz⁽⁶⁾ have used the technique for analysis of morphine using a reverse isotope technique in which d₃ morphine is used as a carrier. In a comparison study of SIM with some of the commonly used morphine quantitation procedures, TLC, GLC, spectrofluorimetry, radioimmunoassay, hemagglutination, inhibition, and Auto Analyzer), SIM was found to be at least as sensitive as the radioimmunoassay (RIA) technique but more specific. The RIA technique will detect other opiates as well as morphine, whereas the SIM technique is specific for morphine. Detectability limits have been set at 25 ng/ml⁽⁷⁾ for RIA. The SIM technique detected 5 ng/ml without special attention to the instrumentation. The lower limit of detection was not determined, but is well below 1 ng/ml.

Legend

—··— 209 DDD
 ——— 243 DDT
 ····· 279 Dieldrin
 - - - - 292 Parathion

Carrier Gas: Methane, 30 ml/min
 Column Temperature: 170-250°C,
 10°C/min
 Column: 4 ft. x 2 mm, glass,
 2-1/2 percent DEXSIL
 300 on Supelcoport

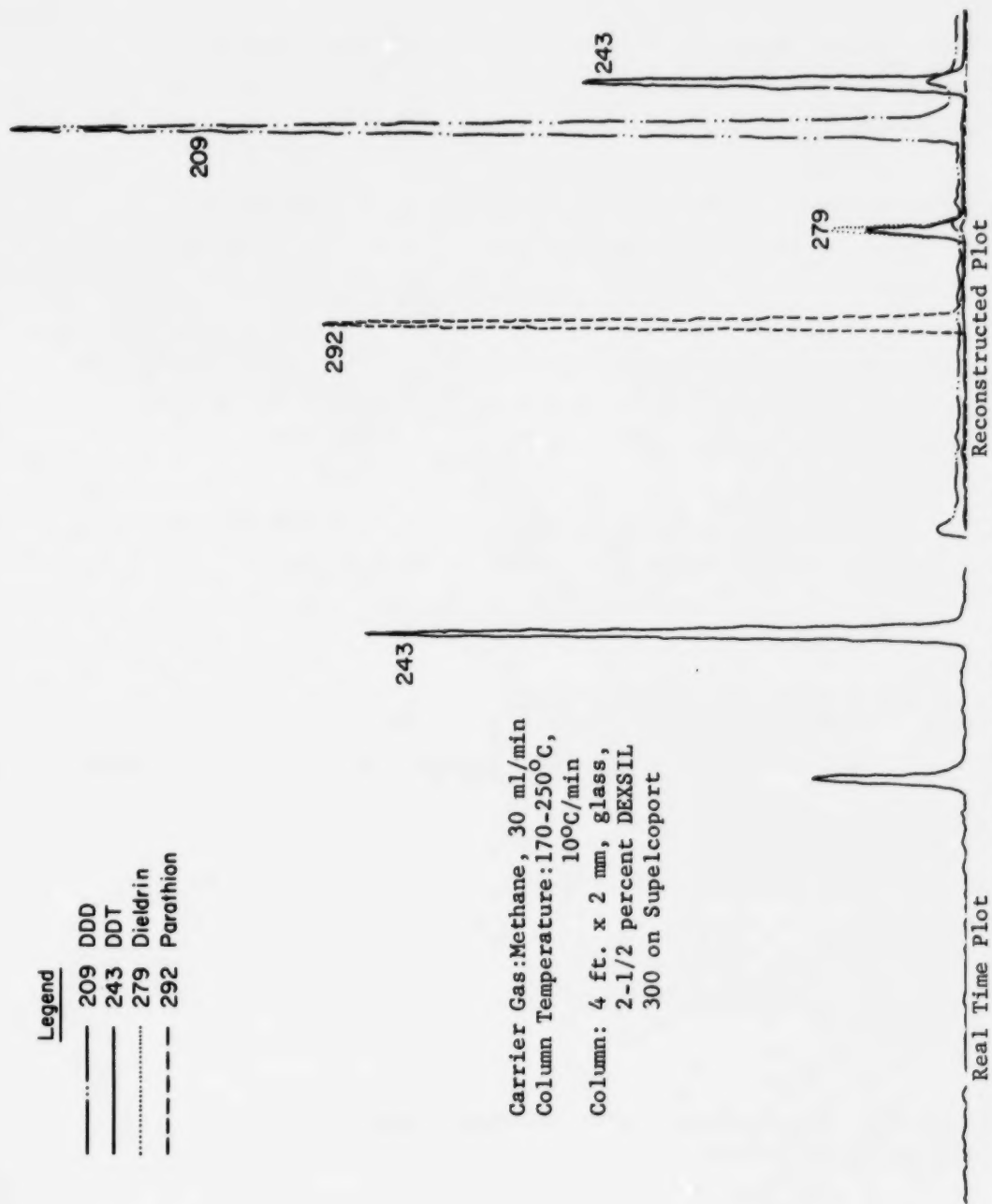


FIGURE 15. SIM PLOTS OF CI GC/MS OF PESTICIDE MIXTURE, 1 ng EACH

SECTION VII

REFERENCES

1. "Mass Fragmentography. Identification of Chlorpromazine and its Metabolites in Human Blood by a New Method", G. G. Hammer, B. Holmstedt, and R. Ryhage, Anal. Biochem., 25, 532 (1968).
2. "Mass Spectrometry of Crude Biological Extracts. Absolute Quantitative Detection of Metabolites at the Submicrogram Level", A. A. Boulton and J. R. Major, J. Chromatography, 48, 322-7 (1970).
3. "Rapid Identification of Low-Molecular Weight Compounds in Extracts of Biological Materials, C. G. Hammar, B. Holmstedt and R. Ketz, J. Chromatography, 49, 402-8 (1970).
4. "Determination of Chromium and Beryllium at the Picogram Level by Gas Chromatography-Mass Spectrometry", W. R. Wolf, M. L. Taylor, B. M. Hughes, T. O. Tiernan, and R. F. Sievers, Anal. Chem., 44, 616-8 (1972).
5. "Smoothing and Differentiation of Digital Data by a Simplified Least Squares Procedure", A. Savitzky, and M.J.E. Golay, Anal. Chem., 8, 1627-38 (1964).
6. "Quantitative Mass Spectral Determination of Morphine in Body Fluid Extracts", P. A. Clarke and R. L. Foltz, Conference on Stable Isotopes in Chemistry, Biology and Medicine at Argonne National Laboratories, Chicago, Illinois, April 1973, Clinical Chemistry, in press.
7. D. Catlin, R. Cleeland, and E. Grunberg, Clinical Chemistry, 19, 216 (1973).

SECTION VIII

APPENDICES

- A. Listing of Data Acquisition Program
- B. Listing of EAE Program

/EAE DEFINITION.

PALS-V7

PAGE 1

/EAE DEFINITION.

0001 EAE=1

```
/SYMSCN
/
/THIS PROGRAM IS WRITTEN FOR A PDP 8/E
/COMPUTER, FINNIGAN 1015 MASS SPECTROMETER
/AND A SYSTEM 150 INTERFACE. THE
/PROGRAM CONTROLS THE MASS SPECTROMETER
/TO PROVIDE MONITORING OF FROM 1 TO 8
/PEAKS FOR SELECTABLE INTEGRATION TIMES,
/WITH FRACTIONAL MASSES PERMITTED. FOR SYSTEMS
/WITH THE KE8-E EXTENDED ARITHMETIC ELEMENT, EAE,
/DEFININF EAE=1 DIRECTS ASSEMBLY OF A PROGRAM USING
/THE EAE INSTRUCTIONS. IF EAE IS NOT DEFINED ( OR
/DEFINED EAE=0 ) SIMULATOR ROUTINES WILL BE ASSEMBLED
/THAT DO NOT NEED THE EAE.
/
/WRITTEN BY:
/    MAYNARD B. NEHER
/    BATTELLE COLUMBUS
/    505 KING AVENUE
/    COLUMBUS, OHIO 43201
/    614-299-3151 EXT 1693
/
/PLIST CONTROLS LISTING OF THE S. I. PLOTTER
/ROUTINES. IF NOT DEFINED ( OR DEFINED EQUAL
/TO ZERO ) THESE ROUTINES ARE NOT LISTED. IF DEFINED
/NONZERO, THE PLOTTER ROUTINES ARE LISTED.
/
IFNDEF PLIST <PLIST=0>
/
/DEFINITIONS FOR 150 INTERFACE IOTS
/
6362 MSIC=6362          /CLEAR IBR
6364 MSI=6364          /INPUT TO IBR
6361 SKMI=6361         /SKIP IF NOT READY FOR INPUT
6371 SKMO=6371         /SKIP IF NOT READY FOR OUTPUT
6372 MSO=6372          /OUTPUT OBR
/
/MISCELLANEOUS DEFINITIONS
/
7301 NL0001=7301       /AC=1
7305 NL0002=7305       /AC=2
7325 NL0003=7325       /AC=3
7307 NL0004=7307       /AC=4
7340 NL7777=7340       /AC=-1
7344 NL7776=7344       /AC=-2
7346 NL7775=7346
/
/EAE DEFINITIONS:
/
7521 SWP=7521
7721 MQAC=7721
7701 MQAR=7701
7421 ACMC=7421
7621 CAM=7621
```

0020 *20

IFNDEF EAE < EAE=0 >

IFZERO EAE <

```
DPIC=JMS I .
          DPICSM
DST=JMS I .
          DSTSM
DLD=JMS I .
          DLDSM
DCM=JMS I .
          DCMSM
DAD=JMS I .
          DADSM
SAM=JMS I .
          SAMSM
ASR=JMS I .
          ASRSM
MUY=JMS I .
          MUYSM
DVI=JMS I .
          DVISM
LSR=JMS I .
          LSRSM >
```

IFNZRO EAE <

```
7573 DPIC=7573
7445 DST=7445
7665 DLD=7665
7575 DCM=7575
7443 DAD=7443
7457 SAM=7457
7415 ASR=7415
7405 MUY=7405
7407 DVI=7407
7417 LSR=7417 >
```

/

/SYSTEM 150 DEFINITIONS:

/

```
5600 LINE=5600
0200 RAD=200
0400 MON=400
0412 READ=MON+12
0601 OPENR=MON+201
0613 OPENW=MON+213
1000 WAIT=MON+400
1400 TTYIN=MON+1000
1401 TTYOUT=MON+1001
0606 CLOSE=MON+206
0404 WRITE=MON+4
1200 EXEC=MON+600
```

```

1402 PLOTTR=MON+1002
4600 INPL=4600
5000 PL=INPL+200
5101 PLR=INPL+301
5110 QUES=INPL+310
5122 TTYT=INPL+322
5125 TTPRI=INPL+325
5132 TTYCR=INPL+332
5200 DEO=INPL+400
5300 DEO4=INPL+500
5323 GAC=INPL+523
5532 TRANS=INPL+732
5541 R1=INPL+741
5543 TTRDI=INPL+743
1600 LOAD=MON+1200

```

/STORAGE DEFINITIONS:

```

0243 PNUM=243           /NUMBER OF POINTS PER MASS.
0244 BSET=244           /NUMBER OF SETS OF MASSES.
0245 NUMMAS=245         /NUMBER OF MASSES.
0246 MASS=0246         /MASSES TO BE MONITORED.
0266 TIME=0266         /INTEGRATION TIMES.
                        /1205 WORD BUFFER, STARTING CA. 6000.
7300 RODVLT=7300       /SETTINGS FOR MONITORED MASSES
7360 PLTBUF=7360       /SMOOTHING BUFFER.
7400 CMASS=7400        /PACKED CALIBRATION FILE POINTS -M
7500 CALSET=7500       /ROD SETTINGS

00020 6000 ABUF0, BUF0
00021 5200 ADEO, DEO
00022 5300 ADEO4, DEO4
00023 0246 ADMASS, MASS
00024 0000 ADMAS1, 0
00025 0000 ADSTOR, 0
00026 0266 ADTIME, TIME
00027 4600 AINPL, INPL
00030 2400 AINTOF, INTOF
00031 2410 AINTON, INTON
00032 5600 ALINE, LINE
00033 0245 AMASS1, NUMMAS
00034 6000 AMPFTR, 6000
00035 5724 ASTCAL, SETCAL
00036 3400 ANPNTS, NPNTS
00037 5000 APL, PL
00040 5101 APLR, PLR
00041 0243 APNUM, PNUM
00042 5110 AQUES, QUES
00043 4356 ARGCHR, RCGCHR
00044 0000 ASETT, 0
00045 3014 ASTINT, STINIT
00046 0000 ATIME, 0
00047 5125 ATTPRI, TTPRI
00050 5543 ATTRDI, TTRDI
00051 5532 ATRANS, TRANS
00052 0000 BUFLOC, 0

```

00053	0000	CBUFF,	0
00054	0606	CLOSEX,	CLOSE
00055	3617	DIVIDI,	DIVIDE
00056	0000	DIVNUM,	0
00057	3472	DSPF,	SPF
00060	3075	ENDCKI,	ENDCHK
00061	1200	EXECX,	EXEC
00062	0000	FACTOR,	0
00063	5640	FRCNVI,	FRCNVT
00064	3565	HDRBLK,	HDBLOK
00065	0000	LMASS,	0
00066	0000	LOCMAS,	0
00067	0000	LOCTIM,	0
00070	7722	M56,	-56
00071	0000	MASCTR,	0
00072	0000	MLEN,	0
00073	0000	MNMASS,	0
00074	0000	MNUM,	0
00075	3662	MULTI,	MULT
00076	0000	NMASS,	0
00077	0244	NSET,	BSET
00100	0000	NTIME,	0
00101	6573	NWORDS,	-1205
00102	0601	OPENRX,	OPENR
00103	0613	OPENWX,	OPENW
00104	0031	P31,	31
00105	0000	PTCTR,	0
00106	0000	PNTLEN,	0
00107	4000	PLOTT,	PLOTX
00110	7360	PTBUF,	PLTBUF
00111	0412	READX,	READ
00112	7300	RODLOC,	RODVL
00113	0000	RODSTT,	0
00114	0000	SETFLG,	0
00115	0000	SFACT,	0
00116	0000	SMASS,	0
00117	0000	TADMAS,	0
00120	0000	TADTIM,	0
00121	3151	TCHCKI,	TCHECK
00122	0000	TEMP1,	0
00123	0000	TMASS,	0
00124	0000	TOTIME,	0
00125	0000	TOTSET,	0
00126	0000	TRTIME,	0
00127	1400	TTRD,	TTYIN
00130	1401	TTWI,	TTYOUT
00131	6000	WAITL,	-2000
00132	1000	WAITX,	WAIT
00133	0404	WRITEX,	WRITE
00134	3512	WRTFIL,	WRTDAT
00135	0000	WTFLAG,	0
00136	3067	ZROFLI,	ZROFIL
		/PLOTTER COMMANDS.	
00137	4214	APENUP,	PENUP
00140	4230	APENDN,	PENDN

00141	4237	ACRDN,	CRDN
00142	4246	ACRUP,	CRUP
00143	4255	ACHTLF,	CHTLFT
00144	4264	ACHTRT,	CHTRT
00145	4273	ACHLCD,	CHLCDN
00146	4302	ACHLCU,	CHLCUP
00147	4311	ACHROD,	CHRODN
00150	7360	SPTBUF,	PLTBUF
00151	0000	EAETP1,	0
00152	0000	EAETP2,	0

```

      2000  *2000
02000 7200  START,  CLA
02001 4430          JMS I  AINTOF  /TURN MS INTERFACE OFF
02002 1047          TAD          ATTPRI
02003 3530          DCA I  TTWI    /ARM TTY FOR OUTPUT.
02004 4437          JMS I  APL     /PRINT "CALIBRATION FILE:"
02005 3200          TEXT1
02006 0011          11
02007 1050          TAD          ATTRDI
02010 3527          DCA I  TTRD    /ARM TTY FOR INPUT.
02011 4457          JMS I  DSPF
02012 4427          JMS I  AINPL   /READ FILE NAME
02013 4451          JMS I  ATRANS  /MOVE FILE NAME.
02014 0240          RAD+40
02015 0003          3
02016 4442          JMS I  ARUES
02017 5206          JMP          START+6
02020 4502          JMS I  OPENRX  /SEARCH DIRECTORY
02021 5600          LINE
02022 6000          BUF0
02023 5216          JMP          -5
02024 4511          JMS I  READX   /READ FILE
02025 0000          0
02026 0200          200           /WORDS TO READ
02027 6000          BUF0         /STORAGE AREA
02030 0000          0           /DONE FLAG
02031 4532          JMS I  WAITX
02032 4760          JMS I  ACLBUF
02033 5203          JMP          START+3
02034 4445          JMS I  ASTINT  /READ MASSES AND INTEGRATIO
02035 4436          JMS I  ANPNTS  /GET NO. POINTS PER PASS.
02036 4771          JMS I  ARNTIM  /GET MAX. RUN TIME.
02037 4437          JMS I  APL     /PRINT "TITLE:"
02040 3221          TEXT3
02041 0003          3
02042 1050          TAD          ATTRDI
02043 3527          DCA I  TTRD    /ENABLE TTY READ
02044 4457          JMS I  DSPF
02045 4427          JMS I  AINPL   /READ TITLE
02046 4451          JMS I  ATRANS
02047 0200          RAD
02050 0040          40
02051 4442          JMS I  ARUES   /PRINT "???"
02052 5245          JMP          -5
02053 4770          JMS I  PLTFCI  /SET PLOT FACTOR.
02054 3527          DCA I  TTRD    /DISABLE TTY READ
02055 4761          JMS I  ARDFIL
02056 1374          TAD          M1750
02057 3126          DCA          TRTIME /SET RUN TIME COUNTER.
02060 1050          TAD          ATTRDI
02061 3527          DCA I  TTRD    /ENABLE TTY READ
02062 4767          JMS I  PLOTNI  /INITIALIZE PLOTTER.
02063 4765          JMS I  WTDATI
02064 6002          IOF
02065 4431          JMS I  AINTON  /TURN MS INTERFACE ON.

```

02066	4762	RESCAN,	JMS I	DCONTI	/SET STORAGE POINTERS.
02067	1020		TAD	ABUF0	/BUFFER START ADDRESS.
02070	3034		DCA	AMPPTR	
02071	1375		TAD	M1205	/BUFFER LENGTH.
02072	3101		DCA	NWORDS	/COUNTER FOR ZEROFIL
02073	4536		JMS I	ZROFLI	/ZERO-FILL BUFFER.
02074	1020	BUFSET,	TAD	ABUF0	
02075	3025		DCA	ADSTOR	/SET BUFFER POINTER.
02076	1072		TAD	MLEN	
02077	3372		DCA	BUFEND	
02100	4431		JMS I	ANTON	/TURN MS INTERFACE ON.
02101	1074	CYCLE1,	TAD	MNUM	/NO. POINTS PER MASS.
02102	3364		DCA	LPOINT	
02103	1025	CYCLE2,	TAD	ADSTOR	/SET BUFFER
02104	3034		DCA	AMPPTR	/POINTER.
02105	1523		TAD I	TMASS	/NUMBER OF MASSES
02106	7041		CIA		/NEGATE
02107	3071		DCA	MASCTR	/STORE
02110	1120		TAD	TADTIM	/GET AND STORE
02111	3046		DCA	ATIME	TIME ADDRESS.
02112	1113		TAD	RODSTT	/GET AND STORE
02113	3044		DCA	ASETT	/SETTING ADDRESS.
02114	1446	MSLOOP,	TAD I	ATIME	/GET INTEGRATION TIME
02115	1126		TAD	TRTIME	/ADD 1 SEC. COUNTER.
02116	3126		DCA	TRTIME	
02117	1126		TAD	TRTIME	
02120	7510		SPA		/GE. 0?
02121	5327		JMP	MSET	/NO. CONTINUE.
02122	2124		ISZ	TOTIME	/YES. INCREMENT RUN TIME CO
02123	7410		SKP		/TIME LIMIT EXCEEDED?
02124	5443		JMP I	ARGCHR	/YES. EXIT.
02125	1374		TAD	M1750	/NO. RESET 1 SEC. COUNTER.
02126	3126		DCA	TRTIME	
02127	4763	MSET,	JMS I	MSSETI	/SET INTERFACE
02130	4773		JMS I	CHKSTI	
02131	1434		TAD I	AMPPTR	/ADD TO STORED VALUE
02132	3434		DCA I	AMPPTR	/AND STORE.
02133	2034		ISZ	AMPPTR	/INCREMENT POINTER TO MSH.
02134	7430		SZL		/OVERFLOW?
02135	2434		ISZ I	AMPPTR	/YES.
02136	7100		CLL		
02137	2034		ISZ	AMPPTR	/INCREMENT POINTER TO NEXT
02140	2046		ISZ	ATIME	/INCREMENT TIME POINTER.
02141	2071		ISZ	MASCTR	/SET OF MASSES DONE?
02142	5314		JMP	MSLOOP	/NO. DO NEXT ONE.
02143	2364		ISZ	LPOINT	/ALL POINTS DONE?
02144	5303		JMP	CYCLE2	/NO. DO ANOTHER POINT.
02145	1025		TAD	ADSTOR	
02146	3766		DCA I	PLOTP1	
02147	2372		ISZ	BUFEND	/BUFFER FULL?
02150	5354		JMP	RESET	/NO. GET MORE DATA
02151	4534		JMS I	WRTFIL	/YES. WRITE IT OUT.
02152	0005		5		
02153	5274		JMP	BUFSET	/START NEXT BUFFER.
02154	1025	RESET,	TAD	ADSTOR	/RESET FOR NEXT SET OF POIN

02155	1106	TAD	PNTLEN	/NO. LOCATIONS PER SET.
02156	3025	DCA	ADSTOR	/NEXT BUFFER LOCATION.
02157	5301	JMP	CYCLE1	
02160	2200	ACLBUF,	CALBUF	
02161	4322	ARDFIL,	RDFILE	
02162	3600	DCONTI,	DCONST	
02163	2430	MSSETI,	MSSET	
02164	0000	LPOINT,	0	
02165	3143	WTDATI,	WTDATA	
02166	4435	PLOTP1,	PLOTP1	
02167	3323	PLOTNI,	PLOTIN	
02170	3457	PLTFCI,	PLTFCT	
02171	3417	ARNTIM,	RUNTIM	
02172	0000	BUFEND,	0	
02173	4400	CHKSTI,	CHKSET	
02174	6030	M1750,	-1750	
02175	6573	M1205,	-1205	
		///		
	2200	PAGE		

```

2200 *2200
/CALIBRATION FILE PACKING SUBROUTINE.
02200 0000 CALBUF, 0
02201 7200 CLA
02202 1356 TAD ADCMAS /GET CALIBRATION MASS
02203 3024 DCA ADMAS1 /ADDRESS AND STORE.
02204 1357 TAD ACALST /GET VOLTAGE SETTING
02205 3233 DCA ADSET /ADDRESS AND STORE.
02206 1020 TAD ABUF0 /GET BUFFER ADDRESS.
02207 3053 DCA CBUFF /AND STORE.
02210 2053 ISZ CBUFF /INCREMENT POINTER.
02211 1453 TAD I CBUFF /GET FIRST MASS.
02212 7440 SZA /ZERO?
02213 5215 JMP CBUFF1 /NO. CONTINUE.
02214 5600 JMP I CALBUF /ERROR RETURN.
02215 3424 CBUFF1, DCA I ADMAS1 /STORE.
02216 2024 ISZ ADMAS1 /INCREMENT MASS POINTER.
02217 7621 CAM /CLEAR AC AND MQ.
02220 1250 TAD P3 /BUMP POINTER
02221 1053 TAD CBUFF /BY 3 AND
02222 3053 DCA CBUFF /STORE.
02223 1453 TAD I CBUFF /PUT FIRST CAL. WORD
02224 7415 ASR /IN AC. SHIFT RIGHT
02225 0004 4 /4 BITS.
02226 7521 SWP /SWAP AC AND MQ.
02227 2053 ISZ CBUFF /INCREMENT POINTER.
02230 1453 TAD I CBUFF /ADD 2ND CAL. WORD.
02231 7521 SWP /PUT BACK IN ORDER.
02232 7445 DST
02233 0000 ADSET, 0 /STORE.
02234 2233 ISZ ADSET
02235 2233 ISZ ADSET /BUMP POINTER BY 2.
02236 7621 CAM /CLEAR AC AND MQ.
02237 1251 TAD P4 /BUMP POINTER
02240 1053 TAD CBUFF /BY 4
02241 3053 DCA CBUFF /AND STORE.
02242 1453 TAD I CBUFF /GET NEXT MASS
02243 7440 SZA /VALUE=0?
02244 5215 JMP CBUFF1 /NO. PROCESS
02245 3424 DCA I ADMAS1 /YES. ZERO MASS
02246 2200 ISZ CALBUF /UPDATE RETURN
02247 5600 JMP I CALBUF /RETURN
02250 0003 P3, 3
02251 0004 P4, 4
/SUBROUTINE TO DETERMINE ROD VOLTAGE SETTINGS.
02252 0000 CALIB, 0
02253 3116 DCA SMASS /STORE MASS
02254 1116 TAD SMASS
02255 7421 ACMC /PUT MASS IN MQ
02256 3351 DCA NPOINT /ZERO POINTER
02257 1356 TAD ADCMAS /GET CALIBRATED MASS STORAGE
02260 3360 DCA ADMAS2 /ADDRESS AND STORE.
02261 1760 TAD I ADMAS2 /GET FIRST CALIBRATION MASS
02262 7457 SETCA1, SAM /SUBTRACT FROM STORED MASS
02263 7450 SNA /AC=0? (MASS=CALIBRATION MA

```

```

02264 5344      JMP      DONE      /YES. DONE WITH SEARCH.
02265 7710      SPA CLA      /AC>0? (MASS>CALIBRATION MA
02266 5300      JMP      SINTRP    /NO. INTERPOLATE.
02267 2351      ISZ      NPOINT    /YES. CHECK NEXT POINT.
02270 2360      ISZ      ADMAS2    /INCREMENT POINTER
02271 1760      TAD I      ADMAS2  /GET NEXT CALIBRATION PEAK.
02272 7440      SZA      /ZERO?
02273 5262      JMP      SETCA1    /NO. PROCEED.
02274 4440      SETCA2, JMS I      APLR  /PRINT "MASS OUTSIDE
02275 3240      TEXT7      /CALIBRATION RANGE. "
02276 0020      Z0
02277 5652      JMP I      CALIB
02300 1351      SINTRP, TAD      NPOINT
02301 7650      SNA CLA      /FIRST POINT?
02302 5274      JMP      SETCA2    /YES. ERROR.
02303 7340      NL7777      /AC=-1
02304 1351      TAD      NPOINT
02305 1356      TAD      ADCMAS
02306 3065      DCA      LMASS      /POINTER TO PREVIOUS POINT.
02307 1465      TAD I      LMASS    /PREVIOUS CALIBRATION MASS
02310 7457      SAM      /SUBTRACT FROM MASS TO
02311 3354      DCA      INTDIF     /BE CALIBRATED AND STORE
02312 1465      TAD I      LMASS    /PREVIOUS CALIBRATION MASS.
02313 7041      CIA      /NEGATE
02314 1760      TAD I      ADMAS2    /ADD LAST CALIBRATION MASS
02315 3355      DCA      MASDIF
02316 1351      TAD      NPOINT      /LAST POINT COUNTER
02317 1351      TAD      NPOINT
02320 1357      TAD      ACALST     /START OF ROD CALIBRATION F
02321 3333      DCA      HISET      /ADDRESS OF PREVIOUS SETTING
02322 7344      NL7776      /AC=-2
02323 1333      TAD      HISET
02324 3330      DCA      LOWSET     /PREVIOUS ROD SETTING ADDR.
02325 1330      TAD      LOWSET
02326 3342      DCA      LOSETI     /STORE FOR USE LATER.
02327 7665      DLD      /D. P. LOAD
02330 0000      LOWSET, 0      /PREVIOUS ROD SETTING
02331 7575      DCM      /D. P. COMPLEMENT
02332 7443      DAD      /D. P. ADD LAST
02333 0000      HISET, 0      /ROD SETTING
02334 4475      JMS I      MULTI    /MULTIPLY BY
02335 2354      INTDIF     /INTERPOLATION DIFFERENCE
02336 7402      HLT      /MULTIPLY OVERFLOW.
02337 4455      JMS I      DIVIDI    /DIVIDE BY DIFFERENCE
02340 2355      MASDIF     /IN MASSES.
02341 7443      DAD      /ADD PREVIOUS SETTING.
02342 0000      LOSETI, 0      /CALIBRATION VALUE IN AC-MQ
02343 5352      JMP      .+7
02344 1351      DONE, TAD      NPOINT /GET LAST VALUE POINTER.
02345 1351      TAD      NPOINT
02346 1357      TAD      ACALST     /ADDRESS OF VALUE.
02347 3351      DCA      NPOINT     /STORE.
02350 7665      DLD      /D. P. LOAD LAST VALUE.
02351 0000      NPOINT, 0      /CALIBRATION VALUE NOW IN
02352 2252      ISZ      CALIB      /INC. FOR NORMAL RETURN.

```

```
02353 5652      JMP I  CALIB
02354 0000 INTDIF, 0
02355 0000 MASDIF, 0
02356 7400 ADCMAS, CMAS
02357 7500 ACALST, CALSET
02360 0000 ADMAS2, 0
        /SUBROUTINE TO SET POINTERS BEFORE CALLING SETCAL.
02361 0000 PRESET, 0
02362 1117      TAD      TADMAS /SET MASS POINTER.
02363 3024      DCA      ADMAS1
02364 1523      TAD I    TMASS
02365 7041      CIA
02366 3073      DCA      MNMASS
02367 1113      TAD      RODSTT
02370 3772      DCA I    RODADI
02371 5761      JMP I    PRESET
02372 5762 RODADI, RODADD
        ///
        2400 PAGE
```

2400 *2400

```

/INTERFACE CONTROL FOR SYSTEM 50/150/250 MASS
/SPECTROMETER INTERFACE.
/THESE ROUTINES TURN THE INTERFACE
/FIXED SAMPLING PERIOD ON AND OFF, ALLOW THE
/TIME REGISTER TO BE LOADED AND ALLOW A DOUBLE
/PRESISION NUMBER TO BE SENT TO THE MASS SET
/REGISTER.
/THIS SET OF ROUTINES WAS WRITTEN BY:
/      W. J. FIES
/      FINNIGAN CORP.
/      595 N PASTORIA AVE
/      SUNNYVALE, CALIF.
/      408-732-0940
/THIS VERSION DATE:12-2-71
/ADAPTED FOR MASS MONITORING PROGRAM BY:
/      M. B. NEHER
/      BATTELLE MEMORIAL INSTITUTE
/      505 KING AVENUE
/      COLUMBUS, OHIO 43201
/TURN INTERFACE INTERRUPT AND FLAG OFF
/CALLING SEQUENCE:
/      JMS      INTOF
/RETURN IS TO JMS+1
02400 0000 INTOF, 0
02401 7300 CLA CLL
02402 6364 MSI /SEND ZERO TO LOWER IBR
02403 7200 CLA
02404 1300 TAD K340
02405 6364 MSI /SEND COMAND CODE TO UPPER B
02406 7200 CLA
02407 5600 JMP I INTOF /YES. NOW RETURN.
/TURN INTERFACE INTERRUPT AND FLAG ON
/CALLING SEQUENCE:
/      JMS      INTON
/RETURN IS TO JMS+1
02410 0000 INTON, 0
02411 7201 CLA IAC
02412 6364 MSI /SEND 1 TO LOWER IBR
02413 7200 CLA
02414 1300 TAD K340
02415 6364 MSI /SEND COMMAND CODE TO UPPER B
02416 7340 NL7777 /AC=-1
02417 3135 DCA WTFLAG /SET WAIT FLAG
02420 3626 DCA I INTON1
02421 1131 TAD WAITL /SET UP DELAY.
02422 3227 DCA WCOUNT
02423 2227 ISZ WCOUNT /DONE?
02424 5223 JMP -1 /NO. WAIT LONGER.
02425 5610 JMP I INTON
02426 4435 INTON1, PLOTPT
02427 0000 WCOUNT, 0
/SEND INTEGRATION TIME
/CALLING SEQUENCE :

```

```

/      C(AC)=TIME-1
/      JMS      ITIME
/RETURN IS TO JMS+1
/TIME CAN BE BETWEEN 0000 AND 7777
02430 0000  MSSET, 0
02431 7200      CLA
02432 6031      KSF      /CHAR. IN KEYBOARD?
02433 7410      SKP      /NO.
02434 4701      JMS I    RDTTY /YES. PROCESS IT.
02435 1446      TAD I    ATIME /SET LOWER 8 BITS OF TIME.
02436 6361      SKMI     /SKIP IF MS IS NOT READY
02437 7410      SKP      /FOR INPUT.
02440 5236      JMP      .-2
02441 6366      MSIC MSI  /CLEAR IBR AND SEND LOWER 8
02442 7104      CLL RAL   /ROTATE UPPER BITS OF
02443 7006      RTL      /TIME INTO LOWER AC
02444 7006      RTL
02445 0276      AND      K17  /MASK OFF UPPER PART OF AC
02446 1277      TAD      K240 /ADD CONTROL CODE
02447 6364      MSI      /SEND TO UPPER IBR
/SEND MASS NO. TO INTERFACE AND GET AMPLITUDE BACK
/NUMBER IS STORED IN LOCATION SPECIFIED BY ASETT.
/AMPLTD WILL CONTAIN NEW AMPLITUDE AFTER RETURN.
/IF (ASETT) EXCEEDS 0007 7777 OR IS NEGATIVE AN ERRO
/WILL RESULT IN THE VALUE SENT TO THE IBR.
02450 7300      CLA CLL
02451 1444      TAD I    ASETT
02452 6361      SKMI     /WAIT FOR IBR FLAG
02453 7410      SKP
02454 5252      JMP      .-2
02455 6366      MSIC MSI  /CLEAR IBR, SEND LOWER 8 BI
02456 2044      ISZ      ASETT
02457 7006      RTL
02460 7006      RTL
02461 7004      RAL
02462 0276      AND      K17  /MASK
02463 3122      DCA      TEMP1
02464 1444      TAD I    ASETT /GET UPPER HALF.
02465 2044      ISZ      ASETT
02466 0275      AND      K7   /MASK
02467 7106      CLL RTL   /ROTATE INTO POSITION
02470 7006      RTL
02471 1122      TAD      TEMP1 /ADD TO OTHER PART
02472 6364      MSI      /SEND TO UPPER IBR
02473 7200      CLA
02474 5630      JMP I    MSSET /JUMP TO BACKGROUND ROUTINE.
02475 0007      K7,      0007
02476 0017      K17,     0017
02477 0240      K240,    240
02500 0340      K340,    340
02501 2600      RDTTY,   RDKYBD
/SUBROUTINE TO READ MASSES
02502 0000      MASSET, 0
02503 3076      DCA      NMASS /ZERO COUNTER
02504 1117      TAD      TADMAS /GET AND STORE START

```

```

02505 3066      DCA      LOCMAS  /OF MASS TABLE.
02506 4437      JMS I    APL      /PRINT "MASS(ES):"
02507 3224      TEXT4
02510 0005      5
02511 1050      TAD      ATTRDI
02512 3527      DCA I    TTRD
02513 4457      JMS I    DSPF
02514 4427      JMS I    AINPL  /INPUT MASS(ES)
02515 3527      DCA I    TTRD  /DISABLE TTY READ
02516 4421      NXTMAS, JMS I    ADEO  /RETURN OCTAL NUMBER
02517 5335      JMP      LSTMAS  /END OF LINE.
02520 7000      NOP
02521 3466      DCA I    LOCMAS  /STORE NUMBER
02522 2066      ISZ      LOCMAS  /INCREMENT POINTER
02523 1422      TAD I    ADEO4  /TERMINATOR.
02524 1070      TAD      M56
02525 7640      SZA CLA  /DECIMAL POINT?
02526 5331      JMP      .+3     /NO. ASSUME INTEGER.
02527 4463      JMS I    FRCNVI  /GET OCTAL FRACTION.
02530 5340      JMP      MERROR  /ERROR RETURN.
02531 3466      DCA I    LOCMAS  /STORE FRACTION.
02532 2066      ISZ      LOCMAS  /INCREMENT POINTER.
02533 2076      ISZ      NMASS  /INCREMENT COUNTER.
02534 5316      JMP      NXTMAS
02535 1076      LSTMAS, TAD      NMASS
02536 3523      DCA I    TMASS
02537 5702      JMP I    MASSET  /NORMAL RETURN.
02540 2302      MERROR, ISZ      MASSET
02541 2302      ISZ      MASSET
02542 5702      JMP I    MASSET
/SUBROUTINE TO READ INTEGRATION TIMES.
02543 0000      TIMSET, 0
02544 4437      JMS I    APL      /PRINT "INTEG. TIME:"
02545 3231      TEXT5
02546 0007      7
02547 7340      TIMST1, NL7777  /AC=-1
02550 1120      TAD      TADTIM
02551 3067      DCA      LOCTIM
02552 1523      TAD I    TMASS
02553 7041      CIA      /NEGATE
02554 3100      DCA      NTIME
02555 1050      TAD      ATTRDI
02556 3527      DCA I    TTRD  /ENABLE TTY READ
02557 4457      JMS I    DSPF
02558 4427      JMS I    AINPL  /READ INTEGRATION TIME
02561 3527      DCA I    TTRD  /DISABLE TTY READ
02562 4421      NXTIME, JMS I    ADEO  /GET INTEGRATION TIMES
02563 7000      NOP
02564 5372      JMP      SET2
02565 2067      ISZ      LOCTIM  /INCREMENT POINTER
02566 3467      DCA I    LOCTIM  /STORE INTEGRATION TIME
02567 2100      ISZ      NTIME  /INCREMENT COUNTER
02570 5362      JMP      NXTIME  /GET NEXT TIME
02571 5743      JMP I    TIMSET  /FINISHED
02572 1467      SET2,  TAD I    LOCTIM  /GET TIME

```

/SYMSCN

PAL8-V7

PAGE 5-3

02573	2067	ISZ	LOCTIM	/INCREMENT POINTER
02574	3467	DCA I	LOCTIM	/REPEAT FOR NEXT MASS
02575	2100	ISZ	NTIME	/INCREMENT COUNTER
02576	5372	JMP	SET2	/DO NEXT ONE
02577	5743	JMP I	TIMSET	

///
2600 PAGE

```

2600 *2600
/SUBROUTINE TO INTERPRET TELETYPE
/COMMANDS DURING OPERATION.
02600 0000 RDKYBD, 0
02601 6036 KRB /READ TTY KEYBOARD.
02602 3372 DCA STORE
02603 4430 JMS I AINTOF /TURN MS INTERFACE OFF.
02604 1372 TAD STORE
02605 6001 ION
02606 4773 JMS I ATTYT /ECHO.
02607 1050 TAD ATTRDI
02610 3527 DCA I TTRD /ENABLE TTY READ.
02611 1372 TAD STORE
02612 1362 TAD MEE /MINUS E.
02613 7640 SZA CLA /IS CHARACTER E?
02614 5225 JMP CHANGE /NO.
02615 5222 JMP STOP /YES. TERMINATE RUN.
02616 4756 RDK1, JMS I CRLF /PUT OUT CRLF.
02617 6002 END, IOF
02620 4431 JMS I AINTON /TURN MS INTERFACE ON.
02621 5600 JMP I RDKYBD

/Routine TO TERMINATE DATA ACQUISITION
/AND START PLOTTING.
02622 4427 STOP, JMS I AINPL /WAIT FOR CR.
02623 6002 IOF
02624 5443 JMP I ARGCHR
02625 1372 CHANGE, TAD STORE
02626 1363 TAD MCNTRL /MINUS CONTROL-L.
02627 7450 SNA /IS IT CONTROL-L?
02630 5251 JMP ABORT /YES. ABORT.
02631 1364 TAD MESS /MINUS S.
02632 7450 SNA /IS CHARACTER S.
02633 5300 JMP SCHANG /YES.
02634 1365 TAD MTEE /MINUS T.
02635 7450 SNA /IS CHARACTER T?
02636 5351 JMP TCHANG /YES.
02637 1366 TAD MEN /MINUS N.
02640 7450 SNA /IS CHARACTER N?
02641 5255 JMP NCHANG /YES.
02642 1367 TAD MEM /MINUS M.
02643 7450 SNA /IS CHARACTER M?
02644 5265 JMP MCHANG /YES.
02645 1370 TAD MEFF /MINUS F.
02646 7650 SNA CLA /IS CHARACTER F?
02647 5261 JMP FCHANG /YES.
02650 5216 JMP RDK1 /NO. IGNORE.
02651 6002 ABORT, IOF
02652 4537 JMS I APENUP /RAISE PLOTTER PEN
02653 6001 ION
02654 5461 JMP I EXECX / AND RETURN TO EXEC.

/CHANGE NUMBER OF POINTS USED IN
/COMPUTING RUNNING AVERAGE.
02655 1260 NCHANG, TAD NCHRET /RETURN ADDRESS.
02656 3436 DCA I ANPNTS
02657 5757 JMP I ANPNT1 /CHANGE NO. POINTS.

```

```

02660 2666 NCHRET, MCHA1
          /CHANGE PLOT SCALE FACTOR.
02661 1264 FCHANG, TAD      FCHRET /RETURN ADDRESS.
02662 3761 DCA I      APLTFC
02663 5760 JMP I      APLTF1 /CHANGE PLOT FACTOR.
02664 2617 FCHRET, END
          /CHANGE MASSES TO MONITOR.
          /ENTRY OF NEW SETS OF MASSES DURING OPERATION IS NOT
          /POSSIBLE WITH THE NON EAE VERSION UNLESS THE PROGRAM
          /IS ALTERED TO CALL FRCNVT AS AN OVERLAY.
MCHANG,
IFZERO EAE <
          JMP END >
IFNZRO EAE <
02665 4445 JMS I      ASTINT >/REINITIALIZE POINTERS.
02666 4460 MCHA1, JMS I      ENDCKI
02667 7070      7070
02670 6001 ION
02671 4464 JMS I      HDRBLK /WRITE NEW HEADER BLOCK.
02672 6002 IOF
02673 4431 JMS I      AINTON /TURN MS INTERFACE ON.
02674 1050 TAD      ATTRDI
02675 3527 DCA I      TTRD /ENABLE TTY READ,
02676 5677 JMP I      +1
02677 2066 RESCAN
          SCHANG=
02700 4427 MCHA3, JMS I      AINPL /READ SET NO.
02701 4421 JMS I      ADEO
02702 4442 JMS I      AQUES
02703 5300 JMP      MCHA3 /TRY AGAIN.
02704 3477 DCA I      NSET
02705 1477 TAD I      NSET
02706 7041 CIA
02707 1125 TAD      TOTSET
02710 7700 SMA CLA /NUMBER TOO LARGE?
02711 5314 JMP      MCHA4 /NO. NUMBER OK.
02712 4442 JMS I      AQUES /PRINT "???"
02713 5300 JMP      MCHA3 /TRY AGAIN.
02714 3527 MCHA4, DCA I      TTRD /DISABLE TTY READ.
02715 7340 NL7777 /AC=-1
02716 1477 TAD I      NSET /GET SET NO.
02717 3371 DCA      SDIFF
02720 1371 TAD      SDIFF
02721 7450 SNA /NO. >1?
02722 5327 JMP      MCHA5 /NO. ! USE FIRST SET.
02723 7421 ACMC /PUT IN MQ
02724 7405 MUY
02725 3065 P20
02726 7521 SWP /PUT ANSWER IN AC
02727 1112 MCHA5, TAD      RODLOC /START OF VOLTAGE ARRAY
02730 3113 DCA      RODST /START OF THIS SET
02731 1371 TAD      SDIFF
02732 7450 SNA /SET NO. >1?
02733 5340 JMP      MCHA6 /NO. USE FIRST SET.
02734 7421 ACMC /PUT IN MQ

```

02735	7405		MUY		
02736	0104		F31		
02737	7701		MOAR		/PUT ANSWER IN AC.
02740	1026	MCHA6,	TAD	ADTIME	/START OF 1ST TIME ARRAY.
02741	3120		DCA	TADTIM	/START OF THIS SET OF TIMES.
02742	1371		TAD	SDIFF	
02743	7450		SNA		/SET NO. >1?
02744	5346		JMP	MCHA7	/NO.
02745	7721		MOAC		/GET OFFSET FROM MO.
02746	1033	MCHA7,	TAD	AMASS1	/START OF MASS TABLE.
02747	3123		DCA	TMASS	/LOC. OF NO. MASSES.
02750	5266		JMP	MCHA1	
			/CHANGE INTEGRATION TIMES.		
02751	1260	TCHANG,	TAD	NCHRET	
02752	3755		DCA I	TIMSTI	/CHANGE RETURN ADD.
02753	5754		JMP I	ATIMS1	
02754	2547	ATIMS1,	TIMST1		
02755	2543	TIMST1,	TIMSET		
02756	5132	CRLF,	TTYCR		
02757	3405	ANPNT1,	NPNTS1		
02760	3464	APLTF1,	PLTFC1		
02761	3457	APLTFC,	PLTFCT		
02762	7473	MEE,	-305		
02763	7564	MCNTRL,	-214		
02764	7671	MESS,	-107	/214-323	
02765	7777	MTEE,	-1	/323-324	
02766	0006	MEN,	6	/324-316	
02767	0001	MEM,	1	/316-315	
02770	0007	MEFF,	7	/315-307	
02771	0000	SDIFF,	0		
02772	0000	STORE,	0		
02773	5122	ATTYT,	TTYT		
02774	5541	TELRO,	R1		

```

3000 *3000
/SUBROUTINE FOR INITIALIZING POINTERS PRIOR TO CALL
/MASSET AND TIMSET.
00000 0000 PTRS, 0
00001 1023 TAD ADMASS
00002 3117 DCA TADMAS /1ST MASS STORAGE LOC.
00003 1026 TAD AOTIME
00004 3120 DCA TADTIM /1ST TIME STORAGE LOC.
00005 1033 TAD AMASS1
00006 3123 DCA TMASS /LOC. FOR NO. MASSES.
00007 1112 TAD RODLOC
00010 3113 DCA RODSTT
00011 7301 NL0001 /AC=1
00012 3477 DCA I NSET /FIRST SET OF MASSES.
00013 5600 JMP I PTRS
00014 0000 STINIT, 0
00015 4200 JMS PTRS
00016 4662 SET, JMS I AMSSET
00017 4664 JMS I ATIMSET
00020 4435 JMS I ASTCAL
00021 4442 JMS I AQUES
00022 5216 JMP SET
00023 1477 TAD I NSET
00024 1266 TAD M3ST /MINUS 3
00025 7700 SMA CLA /NSET=3?
00026 5253 JMP SETDON /YES.
00027 4437 JMS I APL /PRINT "ANOTHER SET?"
00030 3305 TEXT12
00031 0006 6
00032 4663 JMS I AQUERY
00033 5235 JMP .+2 /CHANGE POINTERS FOR NEXT S
00034 5253 JMP SETDON
00035 2477 ISZ I NSET /INCREMENT NO OF SETS.
00036 1117 TAD TADMAS /INCREMENT
00037 1104 TAD P31 /MASS AND
00040 3117 DCA TADMAS /TIME
00041 1120 TAD TADTIM /POINTERS
00042 1104 TAD P31 /BY
00043 3120 DCA TADTIM /31
00044 1123 TAD TMASS
00045 1104 TAD P31
00046 3123 DCA TMASS
00047 1113 TAD RODSTT
00050 1265 TAD F20
00051 3113 DCA RODSTT
00052 5216 JMP SET
00053 7200 SETDON, CLA /NO MORE SETS.
00054 1477 TAD I NSET
00055 3125 DCA TOTSET /NO. OF SETS OF MASSES.
00056 4200 JMS PTRS
00057 1050 TAD ATTRDI /ARM TTY
00060 3527 DCA I TTRD /FOR INPUT.
00061 5614 JMP I STINIT
00062 2502 AMSSET, MASSET
00063 3547 AQUERY, QUERY

```

```

03064 2543 ATMSET, TIMSET
03065 0020 P20, 20
03066 7775 M3ST, -3
/SUBROUTINE TO WRITE E-O-R FLAG ON DISK OR TAPE.
/SUBROUTINE TO ZERO-FILL BUFFER.
03067 0000 ZROFIL, 0
03070 3434 ZR1, DCA I AMPPTR
03071 2034 ISZ AMPPTR
03072 2101 ISZ NWORDS /DONE?
03073 5270 JMP ZR1 /NO.
03074 5667 JMP I ZROFIL
/SUBROUTINE TO END RECORDS.
03075 0000 ENDCHK, 0
03076 3333 DCA NBLOCK /ZERO BLOCK COUNTER.
03077 1025 TAD ADSTOR /RESET BUFFER ADDRESS TO
03100 3034 DCA AMPPTR /START OF CURRENT SET
03101 1034 TAD AMPPTR /OF MASSES.
03102 1342 TAD M6000 /AMPLITUDE BUFFER START.
03103 1341 ENDC1, TAD M201
03104 2333 ISZ NBLOCK /INCREMENT BLOCK COUNTER.
03105 7540 SMA SZA /DONE?
03106 5303 JMP ENDC1 /NO. DO MORE.
03107 7540 SZA CLA /YES. ANY ROOM LEFT IN BLOC
03110 5327 JMP ENDC2 /YES.
03111 1333 TAD NBLOCK /NO.
03112 1340 TAD M5
03113 7450 SNA /5 BLOCKS?
03114 5317 JMP .+3 /YES.
03115 2333 ISZ NBLOCK /NO. BUMP BLOCK COUNTER
03116 5327 JMP ENDC2
03117 4534 JMS I WRTFIL /WRITE OUT FILE
03120 0005 5
03121 1020 TAD ABUF0 /RESET POINTER
03122 3034 DCA AMPPTR
03123 7301 NL0001 /AC=1
03124 3333 DCA NBLOCK /SET BLOCK COUNTER FOR WRITE
03125 7344 NL7776 /AC=-2
03126 3101 DCA NWORDS /ONLY 2 WORDS TO ZERO OUT.
03127 2034 ENDC2, ISZ AMPPTR
03130 1675 TAD I ENDCHK /GET E-O-R CHARACTER.
03131 3434 DCA I AMPPTR /STORE E-O-R CHAR.
03132 4534 JMS I WRTFIL
03133 0000 NBLOCK, 0
03134 1020 TAD ABUF0
03135 3034 DCA AMPPTR /RESET BUFFER LOCATION
03136 2275 ISZ ENDCHK
03137 5675 JMP I ENDCHK
03140 7773 M5, -5
03141 7577 M201, -201
03142 2000 M6000, -6000
/
03143 0000 WTDATA, 0
03144 4437 JMS I APL /PRINT "DATA"
03145 3211 TEXT2
03146 0002 2

```

```
03147 4427      JMS I  AINPL  /WAIT FOR RESPONSE
03150 5743      JMP I  WTDATA

/
/SUBROUTINE TO CHECK TAPE STATUS.
03151 0000      TCHECK, 0
03152 1764      TAD I  CONFIG /CONFIGURATION WORD.
03153 0362      AND   P4IN  /MASK OFF DISK-TAPE BIT.
03154 7640      SZA CLA /TAPE?
03155 5751      JMP I  TCHECK /NO. DISK. RETURN.
03156 1763      TAD I  BFLAG /YES. GET BACKSPACE FLAG.
03157 7640      SZA CLA /DONE?
03160 5356      JMP    .-2    /NO. WAIT.
03161 5751      JMP I  TCHECK /YES. RETURN.
03162 0004      P4IN, 4
03163 0402      BFLAG, 402
03164 0170      CONFIG, 170

03165 0314      TEXT16, TEXT /CLOSE ERROR!/
03166 1723
03167 0540
03170 0522
03171 2217
03172 2241
03173 0000
```

```
03200 3200 *3200
03200 0301 TEXT1, TEXT /CALIBRATION FILE: /
03201 1411
03202 0222
03203 0124
03204 1117
03205 1640
03206 0611
03207 1405
03210 7240
03211 0000
03211 3211 *. -1
03211 0401 TEXT2, TEXT /DATA FILE NAME: /
03212 2401
03213 4006
03214 1114
03215 0540
03216 1601
03217 1505
03220 7240
03221 0000
03221 3221 *. -1
03221 2411 TEXT3, TEXT /TITLE:/
03222 2414
03223 0572
03224 0000
03224 3224 *. -1
03224 1501 TEXT4, TEXT /MASS(ES): /
03225 2323
03226 5005
03227 2351
03230 7240
03231 0000
03231 3231 *. -1
03231 1116 TEXT5, TEXT /INTEGRA. TIME: /
03232 2405
03233 0722
03234 0156
03235 4024
03236 1115
03237 0572
03240 4000
03240 3240 *. -1
03240 1501 TEXT7, TEXT /MASS OUTSIDE CALIBRATION RANGE. /
03241 2323
03242 4017
03243 2524
03244 2311
03245 0405
03246 4003
03247 0114
03250 1102
03251 2201
03252 2411
03253 1716
```

```

03254 4022
03255 0116
03256 0705
03257 5640
03260 0000
      3260 *. -1
03260 0425 TEXT8, TEXT /DUPLICATE FILE NAME!/
03261 2014
03262 1103
03263 0124
03264 0540
03265 0611
03266 1405
03267 4016
03270 0115
03271 0541
03272 0000
      3272 *. -1
03272 1617 TEXT9, TEXT /NO. POINTS: /
03273 5640
03274 2017
03275 1116
03276 2423
03277 7240
03300 0000
      3300 *. -1
03300 2225 TEXT10, TEXT /RUN TIME: /
03301 1640
03302 2411
03303 1505
03304 7240
03305 0000
      3305 *. -1
03305 0116 TEXT12, TEXT /ANOTHER SET?/
03306 1724
03307 1005
03310 2240
03311 2305
03312 2477
03313 0000
      3313 *. -1
03313 2303 TEXT15, TEXT /SCALE FACTOR: /
03314 0114
03315 0540
03316 0601
03317 0324
03320 1722
03321 7240
03322 0000

      /SUBROUTINE TO SET POINTERS FOR SETCAL.
      /SUBROUTINE TO INITIALIZE PLOTTER.
03323 0000 PLOTIN, 0
03324 6002 IOF
03325 7340 NL7777 /AC=-1
03326 4507 JMS I PLOTT /SET NEW ORIGIN

```

03327	7301	NL0001	/SET AC=1
03330	4507	JMS I PLOTT	/DRIVE PLOTTER PEN DOWN TO
03331	0000	0	/X AXIS
03332	6030	-1750	
03333	7340	NL7777	/AC=-1
03334	4507	JMS I PLOTT	/SET NEW ORIGIN
03335	7301	NL0001	/SET AC=1
03336	4507	JMS I PLOTT	/RAISE PEN 1" ABOVE
03337	0000	0	/X AXIS.
03340	0100	100	
03341	7340	NL7777	/AC=-1
03342	4507	JMS I PLOTT	/SET NEW ORIGIN.
03343	4540	JMS I APENDN	/LOWER PEN.
03344	1753	TAD I NSMOTI	/POINTS TO SMOOTH
03345	7041	CIA	/NEGATE
03346	3105	DCA PTCTR	/SET POINT COUNTER.
03347	1110	TAD PTBUF	/SET PLOT BUFFER
03350	3052	DCA BUFLOC	/ POINTER.
03351	6001	ION	
03352	5723	JMP I PLOTIN	
03353	4571	NSMOTI, NSMOOT	
03354	0000	/	
03355	0000	TOTAL, 0	
03356	7734	SVTGLY, -44	
03357	0011	11	
03360	0054	54	
03361	0105	105	
03362	0124	124	
03363	0131	131	
03364	0124	124	
03365	0105	105	
03366	0054	54	
03367	0011	11	
03370	7734	-44	
03371	0655	655	

```

      3400  *3400
      /SUBROUTINE TO SET NUMBER OF POINTS FOR AVERAGING.
03400  0000  NPNTS, 0
03401  4437      JMS I   APL      /PRINT "NO. POINTS:"
03402  3272      TEXT9
03403  0006      6
03404  4457      JMS I   DSPF
03405  4427  NPNTS1, JMS I   AINPL  /READ NUMBER OF POINTS.
03406  4421      JMS I   ADEO
03407  4442      JMS I   AQUES  /PRINT "??
03410  5200      JMP      NPNTS  /TRY AGAIN.
03411  3441      DCA I   APNUM
03412  4241      JMS      DIVSET
03413  7410      SKP
03414  5600      JMP I   NPNTS
03415  4442      JMS I   AQUES  /PRINT "??
03416  5201      JMP      NPNTS+1

      /SUBROUTINE TO SET MAXIMUM RUN TIME
03417  0000  RUNTIM, 0
03420  4437      JMS I   APL      /PRINT "RUN TIME:"
03421  3300      TEXT10
03422  0005      5
03423  4457  RUNTM1, JMS I   DSPF
03424  4427      JMS I   AINPL  /READ RUN TIME.
03425  4421      JMS I   ADEO
03426  4442      JMS I   AQUES
03427  5223      JMP      RUNTM1 /TRY AGAIN.
03430  7521      SWP
03431  7200      CLA
03432  7405      MUY
03433  3440      P74
03434  7521      SWP              /PUT PRODUCT IN AC
03435  7041      CIA              /NEGATE
03436  3124      DCA      TOTIME  /AND STORE
03437  5617      JMP I   RUNTIM
03440  0074  P74,  74      /MULTIPLIER TO CONVERT TIME
                        /TO SECONDS.

      /SUBROUTINE TO CALCULATE DIVISOR FOR AMPLITUDE SCA
03441  0000  DIVSET, 0
03442  1441      TAD I   APNUM
03443  7041      CIA
03444  3074      DCA      MNUM
03445  1441      TAD I   APNUM
03446  7421      APMC
03447  7405      MUY
03450  2251      P4
03451  7440      SZR
03452  5641      JMP I   DIVSET  /OVERFLOW. NUMBER TOO LARGE
03453  7521      SWP
03454  3056      DCA      DIVNUM
03455  2241      ISZ      DIVSET  /SET PROPER RETURN
03456  5641      JMP I   DIVSET

      /SUBROUTINE TO SET PLOT SCALING FACTOR
03457  0000  PLTFCT, 0
03460  4437      JMS I   APL      /PRINT "SCALE FACTOR:"

```

```

03461 3313      TEXT15
03462 0007      7
03463 4457      JMS I   DSPF
03464 4427  PLTFC1, JMS I   AINPL   /READ SCALE FACTOR
03465 4421      JMS I   ADEO     /DECIMAL-OCTAL CONVERT
03466 4442      JMS I   AQUES    /ERROR
03467 5264      JMP     PLTFC1   /TRY AGAIN
03470 3062      DCA      FACTOR
03471 5657      JMP I   PLTFCT

/SUBROUTINE TO WRITE DATA RECORDS.
03472 0000  SPF,      0
03473 7200      CLA
03474 1306      TAD      SPF1     /RPT COUNT
03475 3311      DCA      SPF5     /TEMP STORAGE
03476 1032      TAD      ALINE
03477 3307      DCA      SPF2     /STORAGE ADDR
03500 1310  SPF3,  TAD      SPF4     /SPACE FILL
03501 3707      DCA I   SPF2     /STORE
03502 2307      ISZ      SPF2     /UPDATE STR ADDR
03503 2311      ISZ      SPF5     /FINISHED?
03504 5300      JMP      SPF3     /NO
03505 5672      JMP I   SPF      /YES-RETURN
03506 7760  SPF1,  7760          /-20 OCTAL
03507 0000  SPF2,      0
03510 4040  SPF4,  4040
03511 0000  SPF5,      0

/SUBROUTINE TO WRITE DATA RECORDS.
03512 0000  WRTDAT, 0
03513 1712      TAD I   WRTDAT   /GET NO. BLOCKS.
03514 2312      ISZ      WRTDAT
03515 7421      APMC
03516 7405      MUY
03517 3546      P201
03520 7430      SZL
03521 7402      HLT
03522 7521      SWP
03523 3335      DCA      WRTNUM
03524 1335      TAD      WRTNUM
03525 7041      CIA
03526 3101      DCA      NWORDS   /COUNT F00P PZER FILL.
03527 1020      TAD      ABUF0    /SET POINTER FOR
03530 3034      DCA      AMPPTR   /FOR ZROFIL.
03531 4430      JMS I   AINTOF
03532 6001      ION
03533 4533      JMS I   WRITEX
03534 0000      0
03535 0000  WRTNUM, 0           /NO. WORDS TO WRITE
03536 6000      BUF0           /ADDRESS.
03537 0000      0             /DONE FLAG
03540 4532      JMS I   WAITX
03541 7200      CLA
03542 4521      JMS I   TCHCKI
03543 6002      IOF
03544 4536      JMS I   ZROFLI   /ZERO-FILL BUFFER
03545 5712      JMP I   WRTDAT

```

```

03546 0201 P201, 201
03547 0000 QUERY, 0 /QUESTION SUBROUTINE.
03550 1050 TAD ATTRDI
03551 3527 DCA I TTRD /ENABLE TTY READ.
03552 4427 JMS I AINPL /READ ANSWER.
03553 3527 DCA I TTRD /DISABLE TTY INPUT
03554 1432 TAD I ALINE /GET ANSWER
03555 0364 AND P7700 /MASK OFF FIRST 6 BITS
03556 1363 TAD YNEG /SUBTRACT "Y"
03557 7650 SNA CLA
03560 5747 JMP I QUERY /POSITIVE RETURN.
03561 2347 ISZ QUERY
03562 5747 JMP I QUERY /NEGATIVE RETURN.
03563 4700 YNEG, 4700
03564 7700 P7700, 7700
/SUBROUTINE TO WRITE HEADER BLOCK.
03565 0000 HDBLOK, 0
03566 4533 JMS I WRITEX /WRITE TAPE HEADER BLOCK.
03567 0000 0
03570 0200 200 /NO. WORDS.
03571 0200 RAD /WRITE START ADDRESS.
03572 0000 0 /DONE FLAG
03573 4532 JMS I WAITX
03574 7200 CLA
03575 4521 JMS I TCHCKI
03576 5765 JMP I HDBLOK

```

```

      3600 *3600
      /SUBROUTINE TO CALCULATE CONSTANTS FOR DATA ACQUI
DCONST, 0
03600 0000 TAD I TMASS /GET NO. OF MASSES.
03601 1523 CLL RAL /MULTIPLY BY 2.
03602 7104 DCA PNTLEN
03603 3106 TAD P1205 /MAX. BUFFER LENGTH
03604 1216 ACOMC /PUT IN MQ
03605 7421 DVI
03606 7407 PNTLEN
03607 0106 SZL
03610 7430 HLT /DIVIDE ERROR.
03611 7402 SWP /QUOTIENT TO AC.
03612 7521 CIA /NEGATE
03613 7041 DCA MLEN /NUMBER OF SETS OF POINTS.
03614 3072 JMP I DCONST /RETURN.
03615 5600 P1205, 1205
03616 1205 /EAE ROUTINE TO DIVIDE UNSIGNED DOUBLE PRECISION
      /DIVIDEND BY UNSIGNED SINGLE PRECISION DIVISOR
      /CALLING SEQUENCE:
      / AC CONTAINS HIGH ORDER DIVIDEND.
      / MQ CONTAINS LOW ORDER DIVIDEND.
      / JMS I (DIVIDE)
      / DIVISOR ADDRESS
03617 0000 DIVIDE, 0
03620 4320 JMS SIGN1
03621 7521 SWP /PUT MSH DIVIDEND IN MQ.
03622 3260 DCA DIVI1 /STORE LSH DIVIDEND
03623 1617 TAD I DIVIDE /GET ADDRESS OF
03624 3261 DCA DIVI2 /DIVISOR AND STORE.
03625 1661 TAD I DIVI2 /GET DIVISOR
03626 4336 JMS SIGN2
03627 3261 DCA DIVI2 /AND STORE.
03630 7407 DVI
03631 3661 DIVI2
03632 7430 SZL
03633 7402 HLT /DIVIDE ERROR
03634 7521 SWP /MSH TO AC, REM TO MQ.
03635 3262 DCA DIVI3 /STORE MSH QUOTIENT
03636 1260 TAD DIVI1 /GET LSH DIVIDEND
03637 7521 SWP /PUT IN PROPER ORDER.
03640 7407 DVI
03641 3661 DIVI2
03642 7430 SZL
03643 7402 HLT /DIVIDE ERROR
03644 7104 CLL RAL /MULTIPLY REMAINDER BY 2
03645 7041 CIA / AND NEGATE.
03646 1261 TAD DIVI2 /ADD DIVISOR.
03647 7750 SPA SNA CLA /DIVISOR GE. REMAINDER?
03650 5253 JMP .+3 /NO.
03651 1262 TAD DIVI3 /YES. GET MSH QUOTIENT.
03652 5255 JMP .+3
03653 1262 TAD DIVI3
03654 7573 DPIC /INCREMENT QUOTIENT.
03655 2217 ISZ DIVIDE

```

```

03656 4344      JMS      SIGN2
03657 5617      JMP I    DIVIDE
                /QUOTIENT IN AC-MQ ON RETURN, MSH IN AC.
03660 0000      DIVI1, 0
03661 0000      DIVI2, 0
03662 0000      DIVI3, 0
                /EAB MULTIPLY ROUTINE.
                /MULTIPLIES DOUBLE PRECISION MULTIPLICAND IN MQ-AC
                /BY SINGLE PRECISION MULTIPLIER. RETURNS DOUBLE
                /PRECISION PRODUCT IN AC-MQ. HALTS ON MULTIPLY OVE
                /CALLING SEQUENCE:
                /      JMS      (MULT)
                /      JMULTIPLIER ADDRESS
03663 0000      MULT, 0
03664 4320      JMS      SIGN1
03665 3260      DCA      MULT1 /STORE MSH.
03666 1663      TAD I    MULT /GET MULTIPLIER
03667 3261      DCA      MULT2 /ADDRESS.
03670 1661      TAD I    MULT2 /NOW GET MULTIPLIER
03671 4336      JMS      SIGN2
03672 3261      DCA      MULT2 / AND STORE IT.
03673 1260      TAD      MULT1 /GET BACK MSH
03674 7450      SNA      /D.F. ?
03675 5307      JMP      MULT0 /NO.
03676 7521      SWP      /MSH TO MQ.
03677 3260      DCA      MULT1 /STORE LSH
03700 7405      MUY      /MULTIPLY MSH.
03701 3661      MULT2
03702 7440      SZR
03703 7402      HLT
03704 1260      TAD      MULT1 /MULTIPLY OVERFLOW.
03705 7521      SWP      /GET LSH MULTIPLICAND AND
03706 3260      DCA      MULT1 /PUT IN MQ, PRODUCT TO AC.
03707 7405      MULT0, MUY /STORE MSH PRODUCT
03710 3661      MULT2 /MULTIPLY LSH.
03711 7430      SZL
03712 5315      JMP      .+3 /OVERFLOW ERROR.
03713 1260      TAD      MULT1 /NOW ADD MSH PRODUCT
03714 2263      ISZ      MULT /SET UP NORMAL RETURN.
03715 2263      ISZ      MULT /ERROR RETURN.
03716 4344      JMS      SIGN3
03717 5663      JMP I    MULT
                MULT1=DIVI1
                MULT2=DIVI2
                /
03720 0000      SIGN1, 0
03721 7500      SMA      /NEGATIVE?
03722 5331      JMP      SIGNCL /NO.
03723 7575      DCM      /YES. COMPLEMENT.
03724 3260      DCA      DIVI1
03725 7340      NL7777 /AC=-1
03726 3335      DCA      SIGN /SET SIGN SWITCH=-1
03727 1260      TAD      DIVI1
03730 5720      JMP I    SIGN1
03731 3260      SIGNCL, DCA /STORE OPERAND.

```

```

03732 3335      DCA      SIGN      /CLEAR SIGN SWITCH.
03733 1260      TAD      DIVI1     /GET BACK OPERAND.
03734 5720      JMP I    SIGN1     /RETURN.
03735 0000      SIGN,    0
          //
03736 0000      SIGN2,   0
03737 7500      SMA
03740 5736      JMP I    SIGN2     /NEGATIVE?
03741 7041      CIA
03742 2335      ISZ      SIGN      /NO.
03743 5736      JMP I    SIGN2     /YES. NEGATE.
          //
03744 0000      SIGN3,   0
03745 3260      DCA      DIVI1     /STORE MSH ANSWER.
03746 1335      TAD      SIGN      /CHECK SIGN.
03747 7640      SZA      CLA      /ZERO.
03750 5353      JMP      .+3       /NO.
03751 1260      TAD      DIVI1     /GET BACK MSH ANSWER.
03752 5744      JMP I    SIGN3
03753 1260      TAD      DIVI1
03754 7575      DCM
03755 5744      JMP I    SIGN3     /COMPLEMENT ANSWER.

```

/ ONE OF THE EAE SIMULATOR ROUTINES.

IFZERO EAE <

```

LSRSM, 0
      DCA      EAETP1  /SAVE AC
      TAD I    LSRSM   /GET NUMBER OF SHIFTS
      ISZ      LSRSM
      SZA
      JMP      .+3     /NO SHIFTS?
      TAD      EAETP1  /RESTORE AC
      JMP I    LSRSM
      CIA
      DCA      EAETP2
      TAD      EAETP1  /RESTORE AC
LSRLP, CLL RAR      /ROTATE MSH 1 BIT
      SWP
      RAR
      SWP
      ISZ      EAETP2  /DONE?
      JMP      LSRLP   /NO
      JMP I    LSRSM >

```

IFZERO PLIST <XLIST> /RESET IF NOT LISTING PLOTTER ROUTINES.
 /SUBROUTINE TO GET DATA FILE NAME AND
 /DETERMINE WHETHER THERE IS ALREADY A FILE
 /BY THAT NAME ON THE SYSTEM DEVICE.

```

04322 0000 RDFILE, 0
04323 4437 JMS I APL /PRINT "DATA FILE NAME:"
04324 3211 TEXT2
04325 0010 10
04326 1050 RDF1, TAD ATTRDI
04327 3527 DCA I TTRD /ENABLE TTY READ.
04330 4457 JMS I DSPF
04331 4427 JMS I AINPL /READ FILE NAME
04332 3527 DCA I TTRD /DISABLE TTY READ.
04333 4503 JMS I OPENHX /DOES FILE EXIST?
04334 5600 LINE /FILE NAME ADDRESS.
04335 6000 BUF0
04336 5344 JMP .+6
04337 4440 JMS I APLR /PRINT "DUPLICATE FILE NAME
04340 3260 TEXT8
04341 0012 12
04342 4442 JMS I AQUES /PRINT "???"
04343 5326 JMP RDF1 /TRY AGAIN.
04344 4451 JMS I ATRANS /MOVE FILE NAME
04345 4353 RDF2
04346 0003 3
04347 5347 JMP .-5 /ERROR RETURN.
04350 7000 NOP
04351 4464 JMS I HDRBLK
04352 5722 JMP I RDFILE
04353 0000 RDF2, 0
04354 0000 0
04355 0000 0

/
04356 0000 RCGCHR, 0
04357 4460 JMS I ENDCKI /INSERT RECORD END.
04360 7171 7171 /EOF FLAG.
04361 4430 JMS I AINTOF /TURN OFF MS INTERFACE.
04362 4537 JMS I APENUP /RAISE PLOTTER PEN.
04363 6001 ION
04364 4454 JMS I CLOSEX /CLOSE FILE
04365 4353 RDF2
04366 5600 LINE
04367 0000 0
04370 7410 SKP /ERROR RETURN
04371 5376 JMP TERMIN
04372 4521 JMS I TCHCKI
04373 4440 JMS I APLR /PRINT "CLOSE ERROR!"
04374 3165 TEXT16
04375 0006 6
04376 4521 TERMIN, JMS I TCHCKI
04377 5461 JMP I EXECK

```

```

4400 *4400
/SUBROUTINE TO HANDLE DATA DURING M. S.
/INTERFACE INTEGRATION.
04400 0000 CHKSET, 0
04401 1135 TAD WTFLAG /GET WAIT FLAG
04402 7510 SPA /USE THIS POINT?
04403 5273 JMP WAIT2 /NO.
04404 1235 TAD PLOTPT
04405 7650 SNA CLA /POINT TO PLOT?
04406 5265 JMP WAIT1 /NO.
04407 1114 TAD SETFLG
04410 7650 SNA CLA /TIME TO MOVE POINTS?
04411 5234 JMP PLOTPT-1 /NO. CALCULATE POINT.
04412 3114 DCA SETFLG /CLEAR FLAG.
04413 1371 TAD NSMOOT /GET NO POINTS TO SMOOTH9
04414 7041 CIA
04415 7001 IAC
04416 3372 DCA CTR /SET COUNTER (-NSMOOT+1)
04417 1150 TAD SPTBUF
04420 3306 DCA PTBUF0
04421 1150 TAD SPTBUF
04422 7001 IAC
04423 3307 DCA PTBUF1
04424 1707 RLOOP, TAD I PTBUF1 /GET VALUE.
04425 3706 DCA I PTBUF0 /MOVE IT DOWN.
04426 2372 ISZ CTR /DONE?
04427 7410 SKP /NO.
04430 5234 JMP PLOTPT-1
04431 2306 ISZ PTBUF0
04432 2307 ISZ PTBUF1
04433 5224 JMP RLOOP
04434 7665 DLD
04435 0000 PLOTPT, 0
04436 4475 JMS I MULTI
04437 0062 FACTOR
04440 7402 HLT /MULTIPLY OVERFLOW.
04441 4455 JMS I DIVIDI
04442 0056 DIVNUM
04443 7721 MQAC
04444 3452 DCA I BUFLOC /STORE IT.
04445 3235 DCA PLOTPT /ZERO PLOT POINT ADD.
04446 2105 ISZ PTCTR /ENOUGH POINTS TO SMOOTH?
04447 7410 SKP /NO.
04450 5253 JMP SMOOTH /YES.
04451 2052 ISZ BUFLOC /BUMP STORAGE POINTER.
04452 5265 JMP WAIT1
04453 4310 SMOOTH, JMS FIT /CALL SMOOTH ROUTINE.
04454 7360 PLTBUF /ARRAY ADD.
04455 3260 DCA PLOTPT
04456 4507 JMS I PLOTT /PLOT POINT.
04457 0000 PLOTPX, 0
04460 0000 PLOTPY, 0
04461 2257 ISZ PLOTPX
04462 7340 NL7777 /AC=-1
04463 3105 DCA PTCTR /RESET COUNTER.

```

```

04464 2114      ISZ      SETFLG  /SET FLAG.
04465 6371 WAIT1, SKMO      /M. S. READY FOR OUTPUT?
04466 7410      SKP      /YES.
04467 5265      JMP      .-2   /NO. WAIT LONGER.
04470 7100      CLL      /LINK MUST BE CLEARED.
04471 6372      MSO      /OUTPUT OBR.
04472 5600      JMP I    CHKSET /RETURN.
04473 6371 WAIT2, SKMO      /MS READY FOR OUTPUT?
04474 7410      SKP      /YES.
04475 5273      JMP      .-2   /NO WAIT LONGER.
04476 6372      MSO      /OUTPUT OBR.
04477 7344      NL7776     /AC=-2
04500 1044      TAD      ASETT  /RESET VOLTAGE ARRAY
04501 3044      DCA      ASETT  /ADDRESS.
04502 2135      ISZ      WTFLAG /BUMP FLAG
04503 7000      NOP
04504 5705      JMP I    .+1
04505 2114      MSLOOP
04506 0000 PTBUF0, 0
04507 0000 PTBUF1, 0
          /SAVITZKY-GOLAY SMOOTHING ROUTINE.
          /THIS VERSION SMOOTHS 11 POINTS.
          /FIRST POINT TO SMOOTH IN CALL+1.
          /SMOOTHED POINT RETURNED IN AC, SINGLE PRECISION.
04510 0000 FIT, 0
04511 1710      TAD I    FIT
04512 3373      DCA      SMADD  /STARTING ADDRESS.
04513 2310      ISZ      FIT
04514 1371      TAD      NSMOOT
04515 7041      CIA
04516 3372      DCA      CTR    /SET UP POINT COUNTER.
04517 1375      TAD      AFACT
04520 3374      DCA      FACT
04521 7621      CAM
04522 7445      DST
04523 3354      TOTAL
04524 1773 SMLoop, TAD I    SMADD
04525 7421      ACMC      /INTENSITY TO MQ.
04526 1374      TAD      FACT
04527 3331      DCA      SML1
04530 4475      JMS I    MULTI  /CALL MULTIPLY ROUTINE.
04531 0000 SML1, 0
04532 7402      HLT
04533 7443      DAD
04534 3354      TOTAL
04535 7445      DST
04536 3354      TOTAL
04537 7621      CAM
04540 2373      ISZ      SMADD  /INCREMENT ADDRESSES.
04541 2374      ISZ      FACT
04542 2372      ISZ      CTR    /DONE?
04543 5324      JMP      SMLoop /NO.
04544 1374      TAD      FACT
04545 3351      DCA      SML2
04546 7665      DLD      /YES. GET TOTAL

```

04547	3354		TOTAL		
04550	4455		JMS I	DIVIDI	/CALL DIVIDE ROUTINE.
04551	0000	SML2,	0		
04552	7500		SMA		/AC. GE. 0?
04553	5356		JMP	.+3	/YES.
04554	7621		CAM		/NO. SET=0!
04555	5710		JMP I	FIT	/EXIT
04556	7440		SZA		/AC=0?
04557	7402		HLT		/NO. OVERFLOW ERROR.
04560	1370		TAD	P1700	
04561	7457		SAM		
04562	7710		SPA CLA		/TOO LARGE?
04563	5366		JMP	.+3	/NO.
04564	1370		TAD	P1700	/YES.
04565	5710		JMP I	FIT	
04566	7721		MRAC		/YES. GET QUOTIENT
04567	5710		JMP I	FIT	/ AND RETURN.
04570	1700	P1700,	1700		
04571	0013	NSMOOT,	13		
04572	0000	CTR,	0		
04573	0000	SMADD,	0		
04574	0000	FACT,	0		
04575	3356	AFACT,	SVTGLY		

/THE REST OF THE EAE SIMULATOR ROUTINES

IFZERO EAE <

*5645

```

MUYSM, 0
      CLA CLL           /SINGLE PRECISION UNSIGNED MULP.
      SWP              /GET MULTIPLIER
      DCA      EAETP1  /STORE
      TAD I    MUYSM  /GET ADDRESS OF MULT.
      DCA      EAETP2
      TAD I    EAETP2 /MULTIPLICAND
      DCA      EAETP2
      ISZ      MUYSM  /UPDATE REURN
      DCA      MP5
      TAD      THIR
      DCA      MP3
MP4,   TAD      EAETP1
      RAR
      DCA      EAETP1
      TAD      MP5
      SNL
      JMP      .+3
      CLL
      TAD      EAETP2
      RAR
      DCA      MP5
      ISZ      MP3
      JMP      MP4
      TAD      EAETP1
      RAR           /LOW ORDER PRODUCT
      SWP           /TO MQ
      TAD      MP5  /HIGH ORDER PRODUCT
      JMP I    MUYSM
MP3,   0
MP5,   0
THIR,  7764
DVISM, 0           /UNSIGNED S. P. DIVIDE
      DCA      EAETP1 /STORE MSH
      SWP      /GET LSH
      DCA      EAETP2 /STORE
      TAD I    DVISM  /GET DIVISOR ADDRESS
      DCA      DIVSOR
      TAD I    DIVSOR /ACTUAL DIVISOR
      CIA      /COMPLIMENT
      DCA      DIVSOR /STORE
      CLL
      TAD      DIVSOR
      TAD      EAETP1
      ISZ      DVISM  /CHECK FOR OVERFLOW
      SZL CLA
      JMP I    DVISM  /OVERFLOW
      TAD      MDV13
      DCA      DIVCNT
      JMP      DV2
DV3,   TAD      EAETP1

```

```

      RAL
      DCA      EAETP1
      TAD      EAETP1
      TAD      DIVSOR
      SZL
      DCA      EAETP1
      CLA
DV2,  TAD      EAETP2
      RAL
      DCA      EAETP2
      ISZ      DIVCNT
      JMP      DV3
      TAD      EAETP2 /QUOTIENT
      SWP      /TO MQ
      TAD      EAETP1
      CLL
      JMP I    DVISM
DIVSOR, 0
DIVCNT, 0
MDV13, -15
DCMSM, 0
      DCA      EAETP1 /STORE MSH
      SWP      /GET LSH TO AC
      CMA CLL CML IAC /COMPLIMENT AC SET LINK TO ZERO
      SWP      /IF AC WAS ZERO
      GLK      /GET LINK BIT
      TAD      EAETP1 /ADD TO MSH
      CIA      /COMPLIMENT
      JMP I    DCMSM
DLDSM, 0
      CAM      /CLEAR AA, MQ
      TAD I    DLDSM /GET ADDRESS
      DCA      .+3
      ISZ      DLDSM /UPDATE RETURN
      DAD      /DOUBLE ADD TO A CLEAR AC, MQ
      0
      JMP I    DLDSM
BUF0=.
*BUF0+1205
DADSM, 0
      DCA      EAETP1 /STORE AC
      TAD I    DADSM /GET ADDRESS OF LSH
      DCA      EAETP2 /STORE
      ISZ      DADSM /UPDATE RETURN
      CLL
      SWP      /SWAP MQ, AC
      TAD I    EAETP2 /LSH(1)+LSH(2)
      SWP      /PUT IN MQ
      GLK      /GET CARRY BIT
      ISZ      EAETP2 /MSH ADDRESS
      TAD I    EAETP2
      TAD      EAETP1 /MSH(1)+MSH(2)
      JMP I    DADSM /DONE.
ASRSM, 0
      DCA      EAETP1 /STORE MSH

```

```

TAD      EATP1
AND      ASRSM1 /GET SIGN BIT
DCA      ASRSM2
TAD I    ASRSM /NUMBER OF SHIFTS
DCA      . +5
ISZ      ASRSM /UPDATE RETURN
TAD      EAETP1
AND      ASRSM3

LSR
0
DCA      EAETP1
TAD      ASRSM2 /GET SIGN
CLL RAL  /INTO LINK
TAD      EAETP1
TAD      ASRSM2 /RESTORE SIGN
JMP I    ASRSM

ASRSM1, 4000
ASRSM2, 0
ASRSM3, 3777
DSTSM, 0
DCA      EAETP1 /STORE MSH IN TEMPORARY
TAD I    DSTSM /GET LSH STORAGE ADDRESS

DCA      EAETP2
MQAR     /MQ TO AC, MQ UNCHANGED.
DCA I    EAETP2
ISZ      EAETP2
ISZ      DSTSM /UPDATE RETURN
TAD      EAETP1 /MSH
DCA I    EAETP2 /STORE
TAD      EAETP1 /RESTOR AC
JMP I    DSTSM /DONE

SAMS, 0
CIA      /COMPLIMENST AC
DCA      EAETP1 /STORE
CLL
MQAR     /MQ TO AC, MQ UNCHANGED.
TAD      EAETP1 /ADD COMPLIMENT
JMP I    SAMS /DONE

DPICSM, 0
SWP      /LSH TO AC.
CLL      /BE SURE L IS CLEAR.
IAC      /INC. LSH.
SWP      /PUT BACK IN ORDER.
SZL      /OVERFLOW OF LSH INC. ?
IAC      /YES. INC. MSH.
JMP I    DPICSM >

```

IFZERO EAE < *6400 >

5640 IFNZRO EAE < *5640

6000 BUF0=6000 >

/DECIMAL TO OCTAL FRACTION CONVERSION ROUTINE.
 /THIS ROUTINE IS OVERLAID BY THE DATA BUFFER
 /IN THE NON EAE VERSION. THEREFORE, NEW SETS OF
 /MASSES CANNOT BE ENTERED DURING A RUN UNLESS
 /THE PROGRAM IS CHANGED TO CALL FRCNVT AS
 /AN OVERLAY WHEN NEEDED.

05640	0000	FRCNVT, 0		
05641	3313	DCA	FRNCTR	
05642	3314	DCA	FRTEMP	
05643	4723	FRCN1, JMS I	AGAC	/GET A CHARACTER.
05644	5301	JMP	FREXIT	/NO MORE CHARACTERS.
05645	1315	TAD	M71	
05646	7540	SMA SZA		/GT. 71(9)?
05647	5305	JMP	FREXT1	/NO.
05650	1316	TAD	N11	
05651	7510	SPA		/GE. 60(0)?
05652	5305	JMP	FREXT1	/NO.
05653	3312	DCA	FRCFCT	
05654	1313	TAD	FRNCTR	
05655	1322	TAD	FRNJMP	
05656	3257	DCA	. +1	
05657	7402	FRCN2, HLT		/CHANGED TO JUMP.
05660	1317	TAD	TENS	
05661	1320	TAD	HUNDRS	
05662	1321	TAD	THOUS	
05663	7421	ACMC		/PUT IN MQ.
05664	7405	MUY		
05665	5712	FRCFCT		
05666	7721	MRAC		/GET ANSWER.
05667	1314	TAD	FRTEMP	/PREV. TOTAL.
05670	3314	DCA	FRTEMP	/NEW. TOTAL.
05671	2313	ISZ	FRNCTR	
05672	7346	NL7775		/AC=-3
05673	1313	TAD	FRNCTR	
05674	7750	SPA SNA CLA		/1ST OR 2ND CHAR?
05675	5243	JMP	FRCN1	/YES. TRY ANOTHER.
05676	4421	JMS I	ADE0	/NO. GET REST, IF ANY.
05677	5305	JMP	. +6	/END OF LINE.
05700	7000	NOP		
05701	7200	FREXIT, CLA		
05702	2240	ISZ	FRCNVT	/INCREMENT RETURN.
05703	1314	TAD	FRTEMP	/GET NUMBER.
05704	5640	JMP I	FRCNVT	/NORMAL RETURN.
05705	7200	FREXT1, CLA		
05706	1313	TAD	FRNCTR	
05707	7640	SZA CLA		/ANY CONVERSION?
05710	5301	JMP	FREXIT	/YES.

```

05711 5640      JMP I   FRCNVT  /ERROR RETURN.
05712 0000      FRCFCT, 0
05713 0000      FRNCTR, 0
05714 0000      FRTEMP, 0
05715 7707      M71,    -71
05716 0011      N11,    11
05717 0554      TENS,    554      /0632-0056
05720 0052      HUNDRS, 52      /0056-0004
05721 0004      THOUS,   0004
05722 5260      FRNJMP, JMP      FRCN2+1
05723 5323      AGAC,    GAC
      /SUBROUTINE TO CALCULATE ROD VOLTAGE SETTINGS
      /FOR NON-INTEGGER MASSES.
05724 0000      SETCAL, 0
05725 4777      JMS I   PRSETI  /SET POINTERS.
05726 1424      TAD I   ADMAS1  /GET INTEGER MASS.
05727 4776      JMS I   ACALIB  /CALCULATE SETTING.
05730 5375      JMP SETERR
05731 7445      DST
05732 3354      TOTAL
05733 2024      ISZ      ADMAS1  /INCREMENT POINTER.
05734 7621      CAM
05735 1424      TAD I   ADMAS1  /GET FRACTIONAL MASS.
05736 7440      SZA      /FRACTIONAL MASS?
05737 5343      JMP      SETC1   /YES.
05740 7665      DLD      /NO.
05741 3354      TOTAL
05742 5361      JMP      SETC2
05743 3115      SETC1, DCA      SFACT
05744 1116      TAD      SMAS5   /GET INTEGER MASS AND
05745 7001      IAC      /INCREMENT.
05746 4776      JMS I   ACALIB  /CALCULATE M+1 SETTING.
05747 5375      JMP      SETERR
05750 7575      DCM      /NEGATE.
05751 7443      DAD      /SUBTRACT PREVIOUS
05752 3354      TOTAL      / VALUE.
05753 7575      DCM      /NEGATE TO MAKE POSITIVE.
05754 7405      MUY      /MULTIPLY BY FRACTIONAL
05755 0115      SFACT      / MASS.
05756 7421      ACMC      /PUT RESULT IN MQ.
05757 7443      DAD      /ADD IN LOWER MASS
05760 3354      TOTAL      / VALUE.
05761 7445      SETC2, DST      /D. P. STORE
05762 0000      RODADD, 0
05763 7621      CAM
05764 2073      ISZ      MNMASS  /DONE?
05765 7410      SKP
05766 5373      JMP      NORRET
05767 2362      ISZ      RODADD  /INCREMENT POINTER.
05770 2362      ISZ      RODADD
05771 2024      ISZ      ADMAS1
05772 5326      JMP      SETCAL+2
05773 2324      NORRET, ISZ      SETCAL /NORMAL RETURN
05774 2324      ISZ      SETCAL
05775 5724      SETERR, JMP I   SETCAL

```

/SYMSCN

PAL8-V7

PAGE 16-2

05776	2252	ACALIB, CALIB
05777	2361	PRSETI, PRESET
		\$

ABORT	2651	ATTRDI	0050	DPIC	7573	MASS	0246
ABUF0	0020	ATTYT	2773	DSPF	0057	MASSET	2502
ACALIB	5776	BFLAG	3163	DST	7445	MCHANG	2665
ACALST	2357	BSET	0244	DVI	7407	MCHA1	2666
ACHLCD	0145	BUFEND	2172	EAE	0001	MCHA3	2700
ACHLCU	0146	BUFLOC	0052	EAETP1	0151	MCHA4	2714
ACHRCD	0147	BUFSET	2074	EAETP2	0152	MCHA5	2727
ACHTLF	0143	BUF0	6000	END	2617	MCHA6	2740
ACHTRT	0144	CALBUF	2200	ENDCHK	3075	MCHA7	2746
ACLBUF	2160	CALIB	2252	ENDCKI	0060	MCNTRL	2763
ACMC	7421	CALSET	7500	ENDC1	3103	MEE	2762
ACRDN	0141	CAM	7621	ENDC2	3127	MEFF	2770
ACRUP	0142	CBUFF	0053	EXEC	1200	MEM	2767
ADCMAS	2356	CBUFF1	2215	EXECX	0061	MEN	2766
ADEO	0021	CHANGE	2625	FACT	4574	MERROR	2540
ADEO4	0022	CHKSET	4400	FACTOR	0062	MESS	2764
ADMAS	0023	CHKSTI	2173	FCHANG	2661	MLEN	0072
ADMAS1	0024	CHLCDN	4273	FCHRET	2664	MNMASS	0073
ADMAS2	2360	CHLCP1	4310	FIT	4510	MNUM	0074
ADPLTW	4175	CHLCUP	4302	FRCFCT	5712	MON	0400
ADSET	2233	CHLC1	4301	FRCNVI	0063	MOAC	7721
ADSTOR	0025	CHRCDN	4311	FRCNYT	5640	MOAR	7701
ADTIME	0026	CHRC1	4317	FRCN1	5643	MSET	2127
AFACT	4575	CHTLFT	4255	FRCN2	5657	MSI	6364
AGAC	5723	CHTL1	4263	FREXIT	5701	MSIC	6362
AINPL	0027	CHTRT	4264	FREXT1	5705	MSLOOP	2114
AINTOF	0030	CHTR1	4272	FRNCTR	5713	MSO	6372
AINTON	0031	CLOSE	0606	FRNJMP	5722	MSSET	2430
ALINE	0032	CLOSEX	0054	FRTEMP	5714	MSSETI	2163
AMASS1	0033	CMASS	7400	GAC	5323	MTEE	2765
AMPPTR	0034	COMPAR	4147	HDBLOK	3565	MULT	3662
AMSSET	3062	CONFIG	3164	HDRBLK	0064	MULTI	0075
ANPNTS	0036	CRDN	4237	HISSET	2333	MULT0	3706
ANPNT1	2757	CRDN1	4245	HUNDRS	5720	MULT1	3657
APENDN	0140	CRLF	2756	INPL	4600	MULT2	3660
APENUP	0137	CRUP	4246	INTDIF	2354	MUY	7405
APL	0037	CRUP1	4254	INTOF	2400	M1205	2175
APLR	0040	CTR	4572	INTON	2410	M1750	2174
APLTFC	2761	CYCLE1	2101	INTON1	2426	M201	3141
APLTF1	2760	CYCLE2	2103	K17	2476	M3ST	3066
APNUM	0041	DAD	7443	K240	2477	M5	3140
AQUERY	3063	DCM	7575	K340	2500	M56	0070
AQUES	0042	DCONST	3600	K7	2475	M6000	3142
ARDFIL	2161	DCONTI	2162	LINE	5600	M71	5715
ARGCHR	0043	DEO	5200	LMASS	0065	NBLOCK	3133
ARNTIM	2171	DEO4	5300	LOAD	1600	NCHANG	2655
ASETT	0044	DIVIDE	3617	LOCMAS	0066	NCHRET	2660
ASR	7415	DIVIDI	0055	LOCTIM	0067	NL0001	7301
ASTCAL	0035	DIVI1	3657	LOSETI	2342	NL0002	7305
ASTINT	0045	DIVI2	3660	LOWSET	2330	NL0003	7325
ATIME	0046	DIVI3	3661	LPOINT	2164	NL0004	7307
ATIMS1	2754	DIVNUM	0056	LSR	7417	NL7775	7346
ATMSET	3064	DIVSET	3441	LSTMAS	2535	NL7776	7344
ATRANS	0051	DLD	7665	MASCTR	0071	NL7777	7340
ATTPRI	0047	DONE	2344	MASDIF	2355	NMASS	0076

NORRET 5773
 NPNTS 3400
 NPNTS1 3405
 NPOINT 2351
 NSET 0077
 NSMOOT 4571
 NSMOTI 3353
 NTIME 0100
 NUMMAS 0245
 NWORDS 0101
 NXTIME 2562
 NXTMAS 2516
 N11 5716
 OPENR 0601
 OPENRX 0102
 OPENW 0613
 OPENWX 0103
 PENDN 4230
 PENUP 4214
 PEN1 4222
 PEN2 4223
 PEN3 4236
 PL 5000
 PLIST 0000
 PLOTA 4020
 PLOTDB 4117
 PLOTDX 4172
 PLOTDY 4173
 PLOTIN 3323
 PLOTMV 4176
 PLOTNA 4174
 PLOTNI 2167
 PLOTNX 4170
 PLOTNY 4171
 PLOTPN 4167
 PLOTP 4435
 PLOTPX 4457
 PLOTPY 4460
 PLOTP1 2166
 PLOTT 0107
 PLOTTT 1402
 PLOTT1 4130
 PLOTT2 4133
 PLOTT3 4136
 PLOTWT 4200
 PLOTX 4000
 PLOTZ 4320
 PLOT1 4027
 PLOT2 4063
 PLOT3 4104
 PLOT4 4126
 PLR 5101
 PLTBUF 7360
 PLTFCT 2170
 PLTFCT 3457

PLTFCT 3464
 PLTWT1 4206
 PNTLEN 0106
 PNUM 0243
 PRESET 2361
 PRSETI 5777
 PTBUF 0110
 PTBUF0 4506
 PTBUF1 4507
 PTCTR 0105
 PTRS 3000
 P1205 3616
 P1700 4570
 P20 3065
 P201 3546
 P3 2250
 P31 0104
 P4 2251
 P4IN 3162
 P74 3440
 P7700 3564
 QUERY 3547
 QUES 5110
 RAD 0200
 RCGCHR 4356
 RDFILE 4322
 RDF1 4326
 RDF2 4353
 RDKYBD 2600
 RDK1 2616
 RDTTY 2501
 READ 0412
 READX 0111
 RESCAN 2066
 RESET 2154
 RLOOP 4424
 RODADD 5762
 RODADI 2372
 RODLOC 0112
 RODSTT 0113
 RODVLT 7300
 RSTAC 4224
 RUNTIM 3417
 RUNTM1 3423
 R1 5541
 SAM 7457
 SCHANG 2700
 SDIFF 2771
 SET 3016
 SETCAL 5724
 SETCA1 2262
 SETCA2 2274
 SETC1 5743
 SETC2 5761
 SETDON 3053

SETERR 5775
 SETFLG 0114
 SET2 2572
 SFACT 0115
 SIGN 3734
 SIGNCL 3730
 SIGN1 3717
 SIGN2 3735
 SIGN3 3743
 SINTRP 2300
 SKMI 6361
 SKMO 6371
 SMADD 4573
 SMASS 0116
 SML00P 4524
 SML1 4531
 SML2 4551
 SMOOTH 4453
 SPF 3472
 SPF1 3506
 SPF2 3507
 SPF3 3500
 SPF4 3510
 SPF5 3511
 SPLTBY 6301
 SPTBUF 0150
 START 2000
 STINIT 3014
 STOP 2622
 STORE 2772
 SVTGLY 3356
 SWP 7521
 TADMAS 0117
 TADTIM 0120
 TCHANG 2751
 TCHCKI 0121
 TCHECK 3151
 TELRD 2774
 TEMP1 0122
 TENS 5717
 TERMIN 4376
 TEXT1 3200
 TEXT10 3300
 TEXT12 3305
 TEXT15 3313
 TEXT16 3165
 TEXT2 3211
 TEXT3 3221
 TEXT4 3224
 TEXT5 3231
 TEXT7 3240
 TEXT8 3260
 TEXT9 3272
 THOUS 5721
 TIME 0266

TIMSET 2543
 TIMSTI 2755
 TIMST1 2547
 TMASS 0123
 TOTAL 3354
 TOTIME 0124
 TOTSET 0125
 TRANS 5532
 TRTIME 0126
 TTPRI 5125
 TTRD 0127
 TTRDI 5543
 TTWI 0130
 TTYCR 5132
 TTYIN 1400
 TTYOUT 1401
 TTYT 5122
 WAIT 1000
 WAITL 0131
 WAITX 0132
 WAIT1 4465
 WAIT2 4473
 WCOUNT 2427
 WRITE 0404
 WRITEX 0133
 WRDAT 3512
 WRTFIL 0134
 WRTNUM 3535
 WTDATA 3143
 WTDATI 2165
 WTFLAG 0135
 YNEG 3563
 ZROFIL 3067
 ZROFLI 0136
 ZR1 3070

/EAE DEFINITION.

PAL8-V7

PAGE 1

/EAE DEFINITION.

/

0001 EAE=1

/SIMPLT.

/

/THIS PROGRAM PREPARES NORMALIZED PLOTS FROM DATA FILES
 /CREATED BY THE "SIM" SCAN PROGRAM. IT USES THE STANDARD
 /SYSTEM 150 PROGRAMS. THIS VERSION REQUIRES A PDP8/E OR
 /S/M BUT INCORPORATES EAE SIMULATOR ROUTINES FOR
 /SYSTEMS WITHOUT THE KES-E EXTENDED ARITHMETIC
 /ELEMENT, EAE. FOR SYSTEMS WITH EAE, DEFINE EAE=1 TO
 /ASSEMBLE A PROGRAM USING THE EAE.

/

/PLIST CONTROLS LISTING OF THE S.I. PLOTTER ROUTINES.
 /IF NOT DEFINED (OR SET EQUAL TO ZERO) THE PLOTTER ROUTINES
 /ARE NOT LISTED. IF SET NONZERO, THE PLOTTER ROUTINES ARE LISTED.

/

IFNDEF PLIST <PLIST=0>

/

```

7701 MCA=7701
6221 LINE=6221
7521 SWP=7521
7621 CAM=7621
0171 RADD=171
7421 MQL=7421
0020 +20
00020 6221 ALINE, LINE
00021 3517 APL, PL
00022 3400 AINPL, INPL
00023 7770 M10, -10
00024 0000 TMP1, 0
00025 0000 TMP2, 0
00026 0000 TMP3, 0
00027 0000 TMP4, 0
00030 4040 BLBL, 4040
00031 0040 P40, 40
00032 3111 ASTORG, SETORG
00033 0601 OPENRX, 601
00034 0000 ORGNUM, 0
00035 0000 TRADD, 0
00036 0000
00037 0000 ABSYRG, 0
00040 3277 AHDRPL, HDRPLT
00041 3027 ARTORG, RTNORG
00042 7510 AMSADD, 7510
00043 0000 PASS, 0
00044 0000 FRFSLG, 0
00045 0000 HYMASS, 0
00046 0000 MSMTCH, 0
00047 0000 INTRVL, 0
00050 0000 MASNUM, 0
00051 0000 CRTMAS, 0
00052 6300 P6300, 6300
00053 3075 RDINTX, INTXD
00054 0000 NPTS, 0
00055 0000 EGINT, 0
00056 0000
00057 7777 LWINT, 7777

```

```
00060 3777 3777
00061 0000 SPCADD, 0
00062 0000 RESET, 0
00063 1010 AYPLT, YRGC
00064 1007 AXPLT, XRGD
00065 0000 PENUD, 0
00066 2357 ATRNON, TRNON
      0100 *100
      /GENERALIZED PLOTTING PROGRAM, ALL MEASUREMENTS IN TERMS
      /OF PLOTTING INCREMENTS (.01'S). NO SCALING DONE BY PLOTTING
      /PROGRAM

      /VARIABLES
00100 0000 X, 0
00101 0000 Y, 0
00102 0000 FACT, 0
      NUMB,
      LL,
00103 0000 SADDR, 0
      LJ,
00104 0000 THETA, 0
      LXADDR,
00105 0000 S, 0
      LYADDR,
00106 0000 DX, 0
      LK,
00107 0000 XMIN, 0
      DTIC,
00110 0000 LN, 0
00111 0000 IX, 0
00112 0000 IY, 0
00113 0000 AX, 0
00114 0000 AY, 0
00115 0000 BX, 0
00116 0000 BY, 0

      /LINKS AND POINTERS
00117 4200 ADPLOT, PLOTX
00120 4406 ADPFETCH, PFETCH
00121 4542 ADSEAL, SUBALF
00122 4510 ADMULT, MULT
00123 4446 ADNEWS, NEWS
00124 4607 ADLTR, LETTER
00125 4720 ADRTAT, ROTATE
00126 4607 OUTPUT, LETTER

      /CONSTANTS
00127 0077 N77, 77
00130 7701 M77, -77
00131 0005 N5, 5
00132 0011 N11, 11
00133 0144 N144, 144
00134 7774 M4, -4
00135 7776 M2, -2
00136 7775 M3, -3
```

```

0067 *67
00067 6042 APENUP, PENUP
00070 6056 APENDN, PENDN
00071 6065 ACRDN, CRDN
00072 6074 ACRUP, CRUP
00073 6103 ACHTLF, CHTLFT
00074 6112 ACHTRT, CHTRT
00075 6200 ACHLCU, CHLCUP
00076 6207 ACHRCO, CHRCO
00077 5646 ADIMOVE, IMOVE
0137 *137
00137 0412 READX, 412
00140 1000 WAITX, 1000
00141 2351 ASTMSP, SETMSP
00142 2676 PTMASC, PLTMAS
00143 6032 APLOTW, PLOTWT
00144 0000 CDMASS, 0
00145 0000 0
00146 0237 P237, 237
00147 3740 MBLBL, -4040
00150 7763 NSMOOT, -15
00151 5400 SMTHX, SMOOTH

```

```
IFNDEF EAE <EAE=0 >
```

```
IFZERO EAE <
```

```

SWAB=7000
EAETP1, 0
EAETP2, 0
DST=JMS I
      DSTSM
DLD=JMS I
      DLDSM
DAD=JMS I
      DADSM
DVI=JMS I
      DVISM
DCM=JMS I
      DCMSM
MUY=JMS I
      MUYSM
LSR=JMS I
      LSRSM
SHL=JMS I
      SHLSM
DPSZ=JMS I
      DPSZSM >

```

```
IFNZRO EAE <
```

```

7431 SWAB=7431
7445 DST=7445
7663 DLD=7663
7443 DAD=7443

```

/SIMPLT

PAL8-V7

PAGE 2-3

7407 DVI=7407
7575 DCM=7575
7405 MUY=7405
7417 LSR=7417
7413 SHL=7413
7451 DPSZ=7451 >

```

02000 2000 *2000
02000 6002 IOF
02001 7621 CAM
02002 4432 JMS I ASTORG /SET ORIGIN
02003 4541 JMS I ASTMSP
02004 4421 JMS I APL
02005 2340 MES1
02006 0003 3 /FILE
02007 4422 JMS I AINPL
02010 6304 6304 /TURN PLOTTER OFF
02011 6001 ION
02012 4433 JMS I OPENRX
02013 6221 LINE
02014 6300 6300 /OPEN FILE
02015 7402 HLT /NO FILE
02016 7201 CLA IAC
02017 3034 DCA ORGNUM
02020 1171 TAD RADD
02021 3035 DCA TRADD
02022 1172 TAD RADD+1
02023 3036 DCA TRADD+1 /SAVE STARTING BLOCK
02024 3037 DCA ABSYRG /ABSOLUTE Y ORIGIN
02025 4771 JMS I RDHDRX
02026 1370 TAD M40
02027 3024 DCA TMP1
02030 1146 TAD P237
02031 3025 DCA TMP2 /FIND END OF TITLE
02032 1425 TAD I TMP2
02033 1147 TAD MBLBL
02034 7640 SZL CLA
02035 5243 JMP .+6
02036 2024 ISZ TMP1
02037 7240 CLA CMA
02040 1025 TAD TMP2
02041 3025 DCA TMP2
02042 5232 JMP .-10
02043 4440 JMS I AHDRPL /PLOT TITLE
02044 1042 TAD AMSADD
02045 3365 DCA P20T1
02046 4441 JMS I ARTORG
02047 3043 DCA PASS
02050 3044 DCA FRFLG /SET IN SEARCH MODE - FIRST TIME FLAG
02051 7240 CLA CMA
02052 3045 DCA HVMASS /SET NO MASS FLAG
02053 3463 DCA I AYPLT
02054 7001 IAC
02055 3464 DCA I AXPLT
02056 5260 JMP .+2
02057 4771 FNDPLT, JMS I RDHDRX /READ HEADER BLOCK
02060 1776 TAD I A244
02061 1372 TAD MSDTNX
02062 3027 DCA TMP4
02063 3046 DCA MSMTCH
02064 1427 TAD I TMP4
02065 3027 DCA TMP4

```

02066	1427	TAD I	TMP4	/# OF POINTS IN SET
02067	3366	DCA	P20T2	
02070	1366	TAD	P20T2	
02071	7104	CLL RAL		
02072	3047	DCA	INTRVL	
02073	1366	TAD	P20T2	
02074	7041	CIA		
02075	3026	DCA	TMP3	
02076	3050	DCA	MASNUM	
02077	2027	ISZ	TMP4	
02100	1045	TAD	HVMASS	/GET FLAG
02101	7640	SZA CLA		
02102	5317	JMP	NOMSCR	/NO CURRENT MASS
02103	4777	JMS I	(DPMAS)	
02104	7041	CIA		
02105	2050	ISZ	MASNUM	
02106	1051	TAD	CRTMAS	/ADD CURRENT MASS
02107	7650	SNA CLA		
02110	5357	JMP	SETFLG	/MASS=CURRETN MASS?
02111	2027	ISZ	TMP4	
02112	2026	ISZ	TMP3	
02113	5303	JMP	.-10	
02114	7240	CLA CMA		/SET NO MATCH FLAG
02115	3046	DCA	MSMTCH	
02116	5357	JMP	SETFLG	
02117	4777	NOMSCR, JMS I	(DPMAS)	
02120	3025	DCA	TMP2	
02121	2050	ISZ	MASNUM	
02122	1042	TAD	AMSADD	
02123	3024	DCA	TMP1	/PREPARE TO TEST IF ALREADY DONE
02124	1370	TAD	M40	
02125	3051	DCA	CRTMAS	
02126	1424	NOMSCR, TAD I	TMP1	
02127	7041	CIA		
02130	1025	TAD	TMP2	
02131	7640	SZA CLA		
02132	5337	JMP	..+5	
02133	2027	ISZ	TMP4	
02134	2026	ISZ	TMP3	/ALREADY BEEN DONE
02135	5317	JMP	NOMSCR	
02136	5767	JMP I	AMNXP	/NO MASS NOT DONE
02137	2024	ISZ	TMP1	
02140	2051	ISZ	CRTMAS	
02141	5326	JMP	NOMSCR	/LOOK AT NEXT ONE
02142	1025	TAD	TMP2	
02143	3051	DCA	CRTMAS	
02144	3046	DCA	MSMTCH	/STORE MASS AND FIX FLAG
02145	3045	DCA	HVMASS	
02146	7201	CLA IAC		
02147	0043	AND	PASS	
02150	7650	SNA CLA		
02151	5354	JMP	..+3	
02152	1051	TAD	CRTMAS	
02153	4542	JMS I	PTMASC	
02154	1051	TAD	CRTMAS	

02155	3765		DCA I	P20T1	
02156	2365		ISZ	P20T1	/SECOND PASS
02157	7240	SETFLG,	CLA	CMA	
02160	1050		TAD		MASNUM
02161	7104		CLL	RAL	
02162	1052		TAD		P6300
02163	3061		DCA		SPCADD
02164	5767		JMP I		AMNMXP
02165	0000	P20T1,		0	
02166	0000	P20T2,		0	
02167	2200	AMNMXP,		2200	
02170	7740	M40,		-40	
02171	3060	RDHDX,		RDHEDR	
02172	2172	MSDTNX,		.	
02173	0245			245	
02174	0276			276	
02175	0327			327	
02176	0244	A244,		244	
		//			
02177	3566				
	2200	PAGE			

```

      2200 *2200
02200 4453 JMS I RDINTX
02201 7201 CLA IAC
02202 0043 AND PASS
02203 3043 DCA PASS /PASS=0 OR 1
02204 7621 CAM
02205 7431 SWAB
02206 1350 TAD P1205
02207 7521 SWP
02210 7407 DVI
02211 0047 INTRVL
02212 7521 SWP
02213 7041 CIA
02214 3054 DCA NPTS
02215 7621 CAM
02216 1045 TAD HVMASS
02217 1046 TAD MSMTCH
02220 7640 SZA CLA
02221 5734 JMP I ASRER1 /NOT AN OPERATIVE PASS
02222 1150 TAD NSMOOT
02223 3106 DCA DX
02224 1043 TAD PASS
02225 7640 SZA CLA
02226 5733 JMP I APLTIT /PASS=1 - PLOT
02227 7621 FRSNZR, CAM
02230 1061 TAD SPCADD
02231 3062 DCA RESET
02232 1054 TAD NPTS
02233 3336 DCA NPTS1
02234 4765 JMS I APRSC1
02235 1061 SURVEY, TAD SPCADD
02236 3246 DCA BGCHK
02237 1061 TAD SPCADD
02240 3267 DCA LOCHK
02241 4551 JMS I SMTHX
02242 1107 TAD XMIN
02243 7640 SZA CLA
02244 5301 JMP DONECK
02245 7663 DLD
02246 0000 BGCHK, 0
02247 7575 DCM
02250 7443 DAD
02251 0055 BGINT
02252 7500 SMA /TEST
02253 5263 JMP LOWCHC /NO GOOD
02254 7621 CAM
02255 1061 TAD SPCADD
02256 3260 DCA +2
02257 7663 DLD
02260 0000 0
02261 7445 DST
02262 0055 BGINT
02263 7663 LOWCHC, DLD
02264 0057 LWINT
02265 7575 DCM

```

02266	7443		DAD	
02267	0000	LOCKH,	0	
02270	7500		SMA	
02271	5301		JMP	DONECK /NO GOOD
02272	7621		CAM	
02273	1061		TAD	SPCADD
02274	3276		DCA	.+2
02275	7663		DLD	
02276	0000		0	
02277	7445		DST	
02300	0057		LWINT	
02301	7621	DONECK,	CAM	
02302	2336		ISZ	NPTS1
02303	5311		JMP	.+6
02304	4732		JMS I	AEBLK1 /EOB
02305	4453		JMS I	RDINTX
02306	1062		TAD	RESET
02307	3061		DCA	SPCADD
02310	5232		JMP	SURVEY-3
02311	1735		TAD I	AP20T2
02312	7041		CIA	
02313	3337		DCA	P22T1
02314	7621	INCRLP,	CAM	
02315	2061		ISZ	SPCADD
02316	2061		ISZ	SPCADD
02317	2337		ISZ	P22T1
02320	7410		SKP	
02321	5235		JMP	SURVEY
02322	1061		TAD	SPCADD
02323	3325		DCA	.+2
02324	7663		DLD	
02325	0000		0	
02326	7500		SMA	
02327	5314		JMP	INCRLP
02330	5731		JMP I	EREFX1 /EOR OR EOF
02331	2410	EREFX1,	EOREOF	
02332	2551	AEBLK1,	EOBLOK	
02333	2600	AFLTIT,	2600	
02334	2400	ASRER1,	2400	
02335	2166	AP20T2,	P20T2	
02336	0000	NPTS1,	0	
02337	0000	P22T1,	0	
02340	0611	MES1,	0611	
02341	1405		1405	/FILE
02342	7740		7740	
02343	0310	MES2,	0310	
02344	0116		0116	
02345	0705		0705	/CHANGE PEN
02346	4020		4020	
02347	0516		0516	
02350	1205	P1205,	1205	
02351	0000	SETMSP,	0	
02352	1355		TAD	22000
02353	3756		DCA I	AXMSCL

/SIMPLT.

PALS-V7

PAGE 4-2

```
02354 5751      JMP I   SETMSF
02355 2000  Z2000,  2000
02356 2732  AXMSCL, YMSCLR
02357 0000  TRNON,   0
02360 1364      TAD     PLOTON
02361 4543      JMS I   APLOTW
02362 7200      CLA
02363 5757      JMP I   TRNON
02364 6302  PLOTON, 6302
02365 3146  APRSC1, PRESRC
      //
      2400  PAGE
```

```

2400 *2400
02400 7201 SRVEY1, CLA IAC
02401 1052 TAD P6300
02402 3061 DCA SPCADD
02403 1054 TAD NPTS /# OF SETS/BLOCK
02404 3226 DCA NPTS2
02405 1461 SRVEY2, TAD I SPCADD
02406 7510 SPA
02407 5230 JMP EOREOF /FOUND EOR OR EOF
02410 7200 CLA
02411 1043 TAD PASS
02412 7650 SNA CLA
02413 5217 JMP .+4
02414 7001 IAC /SET PEN UP
02415 4627 JMS I ARG01
02416 0000 0 /SET Y=0 1 MOVEMENT X PEN UP
02417 1061 TAD SPCADD
02420 1047 TAD INTRVL
02421 3061 DCA SPCADD
02422 2226 ISZ NPTS2
02423 5205 JMP SRVEY2
02424 4453 JMS I RDINTX /NEED NEW BLOCK
02425 5200 JMP SRVEY1
02426 0000 NPTS2, 0
02427 3000 ARG01, RG0PLT
02430 1055 EOREOF, TAD P707
02431 7700 SNA CLA
02432 5261 JMP ENDFIL
02433 1367 TAD M5 /EOR
02434 3226 DCA NPTS2 /SET RETREAT TO 5 BLOCKS
02435 1061 TAD SPCADD
02436 1371 TAD M6300
02437 2226 ISZ NPTS2
02440 7000 NOP
02441 1372 TAD M201 /COMPUTE # TO RETREAT
02442 7500 SNA
02443 5237 JMP .-4
02444 7200 CLA CLL
02445 1226 TAD NPTS2
02446 7700 SNA CLA
02447 5660 JMP I ABK2TH
02450 1172 TAD RADD+1
02451 1226 TAD NPTS2
02452 1172 DCA RADD+1
02453 7420 SNL
02454 7240 CLA CMA
02455 1171 TAD RADD
02456 3171 DCA RADD
02457 5660 JMP I ABK2TH
02460 2057 ABK2TH, FNDPLT
02461 1045 ENDFIL, TAD HYMASS
02462 7650 SNA CLA
02463 5313 JMP STLDOT
02464 1043 TAD PASS
02465 7650 SNA CLA /NO MASS - CHECK PASS

```

/SIMPLT.

PALS-V7

PAGE 5-1

02466	5272	JMP	ENDPS1	/END OF PASS 1
02467	6304	6304		
02470	6001	ION		/END OF RUN ROUTINE
02471	5773	JMP I	EXEEX	
02472	2043	ENDPS1, ISZ	PASS	/SET TO PASS 2
02473	4750	JMS I	FLSHIT	/FLUSH MASSES DONE BUFFER
02474	7663	OLD		
02475	0057	LWINT		
02476	7575	DCM		
02477	7445	DST		
02500	0057	LWINT		
02501	7663	OLD		
02502	0055	BGINI		
02503	7443	DAD		
02504	0057	LWINT		
02505	4777	JMS I	(SHFIT	
02506	3055	DCA	BGINI	
02507	7621	CAM		
02510	1042	TAD	AMSADD	
02511	3774	DCA I	AP20T1	
02512	5333	JMP	RSTFLG	
02513	1043	STLDDOT, TAD	PASS	
02514	7650	SNA CLA		
02515	5333	JMP	RSTFLG	
02516	4775	JMS I	ALFTPN	
02517	4421	JMS I	APL	
02520	2343	MES2		
02521	0005	S		
02522	4422	JMS I	AINPL	
02523	7200	CLA		
02524	1147	TAD	MBLBL	
02525	1420	TAD I	ALINE	
02526	7650	SNA CLA		
02527	5332	JMP	+3	
02530	4432	JMS I	ASTORG	
02531	7410	SKP		
02532	4441	JMS I	ARTORG	
02533	1035	RSTFLG, TAD	TRADD	
02534	3171	DCA	RADD	/RESET ALL POINTERS AND FLAGS
02535	1036	TAD	TRADD+1	
02536	3172	DCA	RADD+1	
02537	7040	CMA		
02540	1045	DCA	HVMAS	
02541	3463	DCA I	AYPLT	
02542	7001	IAC		
02543	3464	DCA I	AXPLT	
02544	7001	IAC		
02545	3034	DCA	ORGNUM	
02546	3037	DCA	ABSYRG	
02547	5660	JMP I	ABK2TH	
02550	3133	FLSHIT, FLUSH		
02551	0000	EOBLK, 0		
02552	7621	CAM		
02553	2061	EOBLK1, ISZ	SFCADD	
02554	1061	TAD	SFCADD	

/SIMPLT.

PAL8-V7

PAGE 5-2

02555	1370	TAD	P273	/CHECK OF END OF BLOCK
02556	7700	SMA	CLA	
02557	5751	JMP	I	EOBLOK
02560	1461	TAD	I	SPCADD
02561	7510	SPA		
02562	5230	JMP		EOREOF
02563	7200	CLA		/FOUND EOR OR EOF
02564	2061	ISZ		SPCADD
02565	5353	JMP		EOBLK1
02566	0707	P707,	707	
02567	7773	M5,	-5	
02570	0273	P273,	273	
02571	1500	M6300,	1500	
02572	7577	M201,	-201	
02573	1200	EXECX,	1200	
02574	2165	AP20T1,	P20T1	
02575	3167	ALFTPn,	LIFTPN	
		//		
02577	3600			
	2600	PAGE		

02600	2600	*2600		
02600	7621	PLTSTP,	CAM	
02601	3044		DCA	FRSFLG
02602	7431		SWAB	
02603	1061		TAD	SPCADD
02604	3062		DCA	RESET
02605	1054		TAD	NPTS /#OF PTS/BLOCK
02606	3266		DCA	NPTS3
02607	4742		JMS I	APRSC2
02610	1061	PLTST1,	TAD	SPCADD
02611	3217		DCA	PLCHR
02612	4551		JMS I	SMTHX
02613	1107		TAD	XMIN
02614	7640		SZA CLA	
02615	5234		JMP	YTOBPL-2
02616	7663		DLD	
02617	0000	PLCHR,	0	
02620	7443		DAD	
02621	0057		LWINT	/SUBTRACT MINIMUM
02622	4777		JMS I	(INORM
02623	3236		DCA	YTOBPL
02624	1037		TAD	ABSYRG
02625	7041		CIA	
02626	1236		TAD	YTOBPL
02627	3236		DCA	YTOBPL /Y VALUE RELATIVE TO CURRENT ORIGIN
02630	1044		TAD	FRSFLG /FIRST TIME?
02631	7640		SZA CLA	
02632	5235		JMP	.+3
02633	2044		ISZ	FRSFLG
02634	7201		CLA IAC	
02635	4672		JMS I	ARGC2 /PLOT IT
02636	0000	YTOBPL,	0	
02637	2266		ISZ	NPTS3
02640	5246		JMP	.+6
02641	4673		JMS I	REBLK2
02642	4453		JMS I	RDINTX
02643	1062		TAD	RESET
02644	3061		DCA	SPCADD
02645	5205		JMP	PLTSTP+5
02646	1674		TAD I	BP20T2
02647	7041		CIA	
02650	3275		DCA	P26T1
02651	7621	INCLP2,	CAM	
02652	2061		ISZ	SPCADD
02653	2061		ISZ	SPCADD
02654	2275		ISZ	P26T1
02655	7410		SKP	
02656	5210		JMP	PLTST1
02657	1061		TAD	SPCADD
02660	3262		DCA	.+2
02661	7663		DLD	
02662	0000		0	
02662	7500		SMA	
02664	5251		JMP	INCLP2
02665	5667		JMP I	EREFX2

```

02666 0000 NPTS3, 0
02667 2430 EREFX2, EOREOF
02670 0000 INTCRT, 0
02671 0000 0
02672 3000 ARGC2, RGCPLT
02673 2551 AEBLK2, EOBLOK
02674 2166 BP20T2, P20T2
02675 0000 P26T1, 0
02676 0000 PLTMAS, 0
02677 7200 CLA
02700 1051 TAD CRTMAS
02701 4744 JMS I ASPTCD
02702 0144 CDMASS
02703 1341 TAD M46
02704 3331 DCA XMSCLR
02705 1332 TAD YMSCLR
02706 1340 TAD MHUN
02707 3332 DCA YMSCLR
02710 1144 TAD CDMASS
02711 0127 AND N77
02712 4323 JMS PLTNUM
02713 1145 TAD CDMASS+1
02714 7002 7002 /BYTE SWAP
02715 0127 AND N77
02716 4323 JMS PLTNUM
02717 1145 TAD CDMASS+1
02720 0127 AND N77
02721 4323 JMS PLTNUM
02722 5676 JMP I PLTMAS
02723 0000 PLTNUM, 0
02724 3334 DCA LTSTOR
02725 1331 TAD XMSCLR
02726 1337 TAD P5
02727 3331 DCA XMSCLR
02730 4743 JMS I ADDLTR
02731 0000 XMSCLR, 0
02732 0000 YMSCLR, 0
02733 0002 2
02734 0000 LTSTOR, 0
02735 0000 0
02736 5723 JMP I PLTNUM
02737 0012 P5, 12
02740 7700 MHUN, -100
02741 7722 M46, -56
02742 3146 APRSC2, PRESRC
02743 4600 ADDLTR, DLTR
02744 3200 ASPTCD, SPOCTD
//
02777 3612
3000 PAGE

```

03000	3000	*3000		
03001	0000	RGCPLT,	0	
03002	3065	DCA	PENUD	
03003	1600	TAD I	RGCPLT	
03004	3210	DCA	YRGC	/Y VALUE
03005	2200	ISZ	RGCPLT	
03006	1065	TAD	PENUD	
03007	4517	JMS I	ADPLOT	
03008	0000	XRGC,	0	
03009	0000	YRGC,	0	
03010	2207	ISZ	XRGC	
03011	1207	TAD	XRGC	
03012	7700	SMA CLA		
03013	5600	JMP I	RGCPLT	
03014	7240	CLA CMA		
03015	4517	JMS I	ADPLOT	/NEW ORIGIN
03016	2024	ISZ	ORGNUM	
03017	1037	TAD	ABSYRG	
03018	1210	TAD	YRGC	
03019	3037	DCA	ABSYRG	
03020	3210	DCA	YRGC	
03021	7001	IAC		
03022	3207	DCA	XRGC	
03023	5600	JMP I	RGCPLT	
03024	0000	RTNORG,	0	
03025	7621	CAM		
03026	1034	TAD	ORGNUM	
03027	7041	CIA		
03028	3065	DCA	PENUD	
03029	1037	TAD	ABSYRG	
03030	7041	CIA		
03031	3242	DCA	. +4	
03032	7001	IAC		
03033	4517	JMS I	ADPLOT	
03034	0000	0		
03035	0000	0		
03036	7240	CLA CMA		
03037	4517	JMS I	ADPLOT	/NEW ORIGIN
03038	7621	CAM		
03039	2065	ISZ	PENUD	
03040	7410	SKP		
03041	5627	JMP I	RTNORG	
03042	7201	CLA IAC		
03043	4517	JMS I	ADPLOT	
03044	4000	4000		
03045	6000	0		
03046	7240	CLA CMA		
03047	4517	JMS I	ADPLOT	
03048	5245	JMP	RTNRG1	
03049	0000	RDHEDR,	0	
03050	6104	6304		
03051	6001	ION		
03052	4537	JMS I	READX	
03053	0000	0		
03054	0200	200		

01066	0100	200
01067	0000	0
01070	4540	JMS I WAITX
01071	7200	CLA
01072	6002	IOF
01073	4466	JMS I ATRNON
01074	5660	JMP I RDHEDR
01075	0000	INTRD, 0
01076	6304	6304
01077	6001	ION
01100	4537	JMS I READX
01101	0000	0
01102	1205	1205
01103	6300	6300
01104	0000	0
01105	4540	JMS I WAITX
01106	6002	IOF
01107	4466	JMS I ATRNON
01110	5675	JMP I INTRD
01111	0000	SETORG, 0
01112	4466	JMS I ATRNON
01113	7240	CLA CMA
01114	4517	JMS I ADPLOT
01115	7201	CLA IAC
01116	4517	JMS I ADPLOT
01117	0200	200
01120	6000	-2000
01121	7240	CLA CMA
01122	4517	JMS I ADPLOT
01123	7201	CLA IAC
01124	4517	JMS I ADPLOT
01125	0000	00
01126	0020	20
01127	7240	CLA CMA
01130	4517	JMS I ADPLOT
01131	7200	CLA
01132	5711	JMP I SETORG
01133	0000	FLUSH, 0
01134	1042	TAD AMSADD
01135	3024	DCA TMP1
01136	1345	TAD M40P30
01137	3025	DCA TMP2
01140	3424	DCA I TMP1
01141	2024	ISZ TMP1
01142	2025	ISZ TMP2
01143	5340	JMP -3
01144	5733	JMP I FLUSH
01145	7740	M40P30, -40
01146	0000	PRESRC, 0
01147	7001	IAC
01150	1052	TAD P6300
01151	3311	DCA SETORG
01152	1711	SRCIT, TAD I SETORG
01153	7510	SPA
01154	5766	JMP I EREFX4

03155	7200	CLA	
03156	2311	ISZ	SETORG
03157	2311	ISZ	SETORG
03160	1311	TAD	SETORG
03161	7041	CIA	
03162	1061	TAD	SPCADD
03163	7710	SPA CLA	
03164	5746	JMP I	PRESRC
03165	5352	JMP	SRCIT
03166	2430	EREFX4, EOREOF	
03167	0000	LIFTPN, 0	
03170	1210	TAD	YRGC
03171	3374	DCA	+3
03172	7001	IAC	
03173	4200	JMS	RGCPLT
03174	0000	0	
03175	5767	JMP I	LIFTPN

//
3200 PAGE

```

3200 *3200
03200 0000 SPOCTD, 0
03201 3261 DCA OCTNUM /STORE NUMBER
03202 1600 TAD I SPOCTD
03203 3262 DCA ADDSSP /ADDRESS FOR RESULT
03204 2200 ISZ SPOCTD
03205 3267 DCA ICHPOT
03206 3270 DCA GOTONE /0 CHAR. POS. AND PREV. CHR. FLG.
03207 1272 TAD AMTHOU /ADD. OF -1000
03210 3273 DCA CURNT
03211 1134 TAD M4 /-4
03212 3274 DCA KPTRAC
03213 3271 LOOPSD, DCA DECCAR
03214 1261 INLPSD, TAD OCTNUM
03215 1673 TAD I CURNT
03216 7510 SPA
03217 5224 JMP +5
03220 2271 ISZ DECCAR
03221 2270 ISZ GOTONE
03222 3261 DCA OCTNUM
03223 5214 JMP INLPSD
03224 7200 CLA /DONE WITH CURRENT POWER OF TEN
03225 1271 TAD DECCAR
03226 7440 SZA /0?
03227 5236 JMP NONZRO
03230 1270 TAD GOTONE
03231 7640 SZA CLA /PREV. NON-ZERO?
03232 5236 JMP NONZRO
03233 1275 TAD FSOC40 /BLANK
03234 3271 DCA DECCAR
03235 5240 JMP STORIT
03236 1276 NONZRO, TAD P60
03237 3271 DCA DECCAR
03240 1267 STORIT, TAD ICHPOT
03241 7740 SZA CLA CLL
03242 5250 JMP SECNDC
03243 2267 ISZ ICHPOT
03244 1271 TAD DECCAR
03245 7002 7002 /BYTE SWAP
03246 3662 DCA I ADDSSP
03247 5255 JMP INCRSP
03250 1662 SECNDC, TAD I ADDSSP
03251 1271 TAD DECCAR
03252 3662 DCA I ADDSSP
03253 3267 DCA ICHPOT
03254 2262 ISZ ADDSSP
03255 2273 INCRSP, ISZ CURNT
03256 2274 ISZ KPTRAC
03257 5213 JMP LOOPSD
03260 5600 JMP I SPOCTD
03261 0000 OCTNUM, 0
03262 0000 ADDSSP, 0
03263 6030 MTHOU, -1750
03264 7634 -144
03265 7766 -12

```

03266	7777	-1	
03267	0000	ICHPOT,	0
03270	0000	GOTONE,	0
03271	0000	DECCAR,	0
03272	3263	AMTHOU,	MTHOU
03273	0000	CURNT,	0
03274	0000	KPTRAC,	0
03275	0040	PSOC40,	40
03276	0060	P60,	60
03277	0000	HDRPLT,	0
03300	1332	TAD	P200
03301	3025	DCA	TMP2
03302	1135	TAD	M2
03303	3333	DCA	HDRT1
03304	1334	TAD	P2066
03305	3345	DCA	YHD
03306	1335	TAD	P20
03307	3344	DCA	XHD
03310	4466	JMS I	ATRNON
03311	1031	TAD	P40
03312	4336	JMS	PLOTHD /BLANK
03313	1425	PROTHD, TAD I	TMP2
03314	2333	ISZ	HDRT1
03315	5326	JMP	UPHBYT
03316	0127	AND	N77
03317	4336	JMS	PLOTHD
03320	2025	ISZ	TMP2
03321	1135	TAD	M2
03322	3333	DCA	HDRT1
03323	2024	ISZ	TMP1
03324	5313	JMP	PROTHD
03325	5677	JMP I	HDRPLT
03326	7002	UPHBYT, 7002	
03327	0127	AND	N77
03330	4336	JMS	PLOTHD
03331	5313	JMP	PROTHD
03332	0200	P200,	200
03333	0000	HDRT1,	0
03334	2044	P2066,	2044
03335	0020	P20,	20
03336	0000	PLOTHD,	0
03337	3347	DCA	HDRT2
03340	1353	TAD	P6
03341	1344	TAD	XHD
03342	3344	DCA	XHD
03343	4754	JMS I	DLTRX
03344	0000	XHD,	0
03345	0000	YHD,	0
03346	0002		2
03347	0000	HDRT2,	0
03350	0000		0
03351	7200	CLA	
03352	5736	JMP I	PLOTHD
03353	0012	P6,	12
03354	4600	DLTRX,	DLTR

/SIMPLT.

PALS-V7

PAGE 8-2

//
3400 PAGE

98<

```

      3400 *3400
03400 0000 INPL, 0
03401 7200 CLA
03402 1023 TAD M10
03403 3024 DCA TMP1
03404 1020 TAD ALINE
03405 3025 DCA TMP2
03406 1030 BLNKFL, TAD BLBL
03407 3425 DCA I TMP2
03410 2025 ISZ TMP2
03411 2024 ISZ TMP1
03412 5206 JMP BLNKFL /FILL BUFFER WITH BLANKS
03413 1020 TAD ALINE
03414 3024 DCA TMP1
03415 1135 TAD M2
03416 3025 DCA TMP2
03417 6031 PCKLN, KSF /WAIT FOR CHARACTER
03420 5217 JMP .-1
03421 6036 KRB /GET CHARACTER
03422 3026 DCA TMP3
03423 1026 TAD TMP3
03424 4310 JMS PRN1CH /ECHO
03425 1026 TAD TMP3
03426 1357 TAD MRBOUT /RUBOUT?
03427 7450 SNA
03430 5201 JMP INPL+1
03431 1360 TAD P106 /_?
03432 7640 SZL CLA
03433 5255 JMP CRTCHK
03434 7001 IAC
03435 1025 TAD TMP2 /POSITION OF LST CHARACTER
03436 7640 SZL CLA
03437 5245 JMP .+6
03440 1135 TAD M2
03441 3025 DCA TMP2 /FLAG WAS -1 - RESET TO -2
03442 1030 TAD BLBL
03443 3424 DCA I TMP1
03444 5255 JMP CRTCHK
03445 7040 CMA
03446 1024 TAD TMP1 /FLAG WAS -2 - MAKE -1
03447 3024 DCA TMP1
03450 2025 ISZ TMP2
03451 1424 TAD I TMP1
03452 0361 AND MASK2
03453 1031 TAD P40
03454 3424 DCA I TMP1
03455 1026 CRTCHK, TAD TMP3
03456 1362 TAD MCRTN
03457 7640 SZL CLA /CARRIAGE RETURN?
03460 5266 JMP .+6
03461 1026 TAD TMP3
03462 4310 JMS PRN1CH
03463 1363 TAD LINEFD
03464 4310 JMS PRN1CH
03465 5600 JMP I INPL

```

00466	1026	TAD	TMP3	
00467	0127	AND	N77	
00470	3026	DCA	TMP3	/STRIP AND RESTORE
00471	2025	ISZ	TMP2	/UPPER OR LOWER BYTE
00472	5303	JMP	UPPRIN	
00473	1424	TAD I	TMP1	
00474	0361	AND	MASK2	
00475	1026	TAD	TMP3	
00476	3424	DCA I	TMP1	
00477	1135	TAD	M2	
00500	3025	DCA	TMP2	
00501	2024	ISZ	TMP1	
00502	5217	JMP	PCKLN	
00503	1026	UPPRIN, TAD	TMP3	
00504	7002	7002		
00505	1031	TAD	P40	
00506	3424	DCA I	TMP1	
00507	5217	JMP	PCKLN	
00510	0000	PRN1CH, 0		
00511	6046	TLS		/PRINT
00512	6041	TSE		/WAIT FOR COMPLETION FLAG
00513	5312	JMP	-1	
00514	7200	CLA		
00515	6042	TCF		
00516	5710	JMP I	PRN1CH	
00517	0000	PL, 0		
00520	1717	TAD I	PL	
00521	3024	DCA	TMP1	
00522	2317	ISZ	PL	
00523	1717	TAD I	PL	
00524	7041	CIA		
00525	3025	DCA	TMP2	
00526	2317	ISZ	PL	
00527	1135	TAD	M2	
00530	3026	DCA	TMP3	
00531	1424	PRTOUT, TAD I	TMP1	
00532	2026	ISZ	TMP3	
00533	5345	JMP	UPOUT	
00534	0127	AND	N77	
00535	4351	JMS	CONVT	
00536	2025	ISZ	TMP2	
00537	7410	SKP		
00540	5717	JMP I	PL	/DONE
00541	2024	ISZ	TMP1	
00542	1135	TAD	M2	
00543	3026	DCA	TMP3	
00544	5331	JMP	PRTOUT	
00545	7002	UPOUT, 7002		
00546	0127	AND	N77	
00547	4351	JMS	CONVT	
00550	5331	JMP	PRTOUT	
00551	0000	CONVT, 0		
00552	1364	TAD	P240	
00553	0365	AND	P277	
00554	1031	TAD	P40	

03555	4310	JMS	FRN1CH
03556	5751	JMP I	CONVT
03557	7401	MRBOUT,	-377
03560	0040	P106,	40
03561	7700	MASK2,	7700
03562	7563	MCRTRN,	-215
03563	0212	LINEFD,	212
03564	0240	P240,	240
03565	0277	P277,	277
03566	0000	OPMASS,	0
03567	1427	TAD I	TMP4
03570	3377	DCA	DPMT
03571	2027	ISZ	TMP4
03572	1427	TAD I	TMP4
03573	7710	SPA CLA	
03574	2377	ISZ	DPMT
03575	1377	TAD	DPMT
03576	5766	JMP I	OPMASS
03577	0000	DPMT,	0
		//	
	3600	PAGE	

```

      3600  *3600
03600  0000  SHFTIT, 0
03601  3246          DCA      TM361
03602  3247          DCA      SHFCNT
03603  1246          TAD      TM361
03604  7510          SPA
03605  5600          JMP I    SHFTIT
03606  7413          SHL
03607  0001          1
03610  2247          ISZ      SHFCNT
03611  5204          JMP      -5
03612  0000  INORM, 0
03613  3246          DCA      TM361
03614  3250          DCA      SHFCN2
03615  1246          TAD      TM361
03616  7451          DPSZ
03617  7410          SKP
03620  5612          JMP I    INORM
03621  7510          SPA
03622  5227          JMP      INORM1
03623  7413          SHL
03624  0001          1
03625  2250          ISZ      SHFCN2
03626  5221          JMP      -5
03627  7417  INORM1, LSR
03630  0001          1
03631  7407          DVI
03632  0055          BGINT
03633  7200          CLA
03634  1250          TAD      SHFCN2
03635  7041          CIA
03636  1247          TAD      SHFCNT
03637  1251          TAD      T3612
03640  7510          SPA
03641  7200          CLA
03642  3244          DCA      +2
03643  7413          SHL
03644  0000          0
03645  5612          JMP I    INORM
03646  0000  TM361, 0
03647  0000  SHFCNT, 0
03650  0000  SHFCN2, 0
03651  0013  T3612, 13

      IFZERO EAE <

      DSTSM, 0
          DCA      EAETP1  /STORE MSH IN TEMPORARY
          TAD I     DSTSM   /GET LSH STORAGE ADDRESS
          DCA      EAETP2
          MQR      /MQR TO AC, MQR UNCHANGED
          DCA I     EAETP2
          ISZ      EAETP2
          ISZ      DSTSM   /UPDATE RETURN
          TAD      EAETP1  /MSH

```

```

DCA I   EAETP2 /STORE
TAD     EAETP1 /RESTOR AC
JMP I   DSTSM /DONE
DCMSM,  0
DCA     EAETP1 /STORE MSH
SWP     /GET LSH TO AC
CMA CLL CML IAC /COMPLIMENT AC SET LINK TO ZERO
SWP     /IF AC WAS ZERO
GLK     /GET LINK BIT
TAD     EAETP1 /ADD TO MSH
CIA     /COMPLIMENT
JMP I   DCMSM
DLDSM,  0
CAM     /CLEAR AC, MQ
TAD I   DLDSM /GET ADDRESS
DCA     .+3
ISZ     DLDSM /UPDATE RETURN
DAD     /DOUBLE ADD TO A CLEAR AC, MQ
0
JMP I   DLDSM
DADSM,  0
DCA     EAETP1 /STORE AC
TAD I   DADSM /GET ADDRESS OF LSH
DCA     EAETP2 /STORE
ISZ     DADSM /UPDATE RETURN
CLL
SWP     /SWAP MQ, AC
TAD I   EAETP2 /LSH(1)+LSH(2)
SWP     /PUT IN MQ
GLK     /GET CARRY BIT
ISZ     EAETP2 /MSH ADDRESS
TAD I   EAETP2
TAD     EAETP1 /MSH(1)+MSH(2)
JMP I   DADSM /DONE
DPSZSM, 0
SZA     /AC=0?
JMP I   DPSZSM /NO - NORMAL RETURN
SWP     /YES - CHECK MQ
SNA     /MQ=0?
ISZ     DPSZSM /YES - UPDATE RETURN FOR SKIP
SWP     /RESTORE
JMP I   DPSZSM

```

```

*4000
MUYSM, 0
CLA CLL /SINGLE PRECISION UNSIGNED MULP.
SWP /GET MULTIPLIER
DCA EAETP1 /STORE
TAD I MUYSM /GET ADDRESS OF MULT.
DCA EAETP2
TAD I EAETP2 /MULTIPLICAND
DCA EAETP2
ISZ MUYSM /UPDATE REURN
DCA MP5
TAD THIR
DCA MP3
MP4, TAD EAETP1
RAR
DCA EAETP1
TAD MP5
SNL
JMP +3
CLL
TAD EAETP2
RAR
DCA MP5
ISZ MP3
JMP MP4
TAD EAETP1
RAR /LOW ORDER PRODUCT
SWP /TO MQ
TAD MP5 /HIGH ORDER PRODUCT
JMP I MUYSM
MP3, 0
MP5, 0
THIR, 7764
DVISM, 0
DCA EAETP1 /UNSIGNED S. P. DIVIDE
SWP /STORE MSH
DCA EAETP2 /GET LSH
TAD I DVISM /STORE
DCA DIVSOR /GET DIVISOR ADDRESS
TAD I DIVSOR /ACTUAL DIVISOR
CIA /COMPLIMENT
DCA DIVSOR /STORE
CLL
TAD DIVSOR
TAD EAETP1
ISZ DVISM /CHECK FOR OVERLOW
SZL CLA
JMP I DVISM /OVERFLOW
TAD MDV13
DCA DIVCNT
JMP DV2
DV3, TAD EAETP1
RAL
DCA EAETP1
TAD EAETP1

```

```

      TAD      DIVSOR
      SZL
      DCA      EAETP1
      CLA
DV2,  TAD      EAETP2
      RAL
      DCA      EAETP2
      ISZ      DIVCNT
      JMP      DV3
      TAD      EAETP2  /QUOTIENT
      SWP      /TO MQ
      TAD      EAETP1
      CLL
      JMP I    DVISM
DIVSOR, 0
DIVCNT, 0
MDV13, -15
SHLSM, 0
      DCA      EAETP1
      TAD I    SHLSM  /# 00 SHIFTS
      ISZ      SHLSM  /UPDATE RETURN
      SZA      /NO SHIFTS?
      JMP      .+3
      TAD      EAETP1  /RESTOR AC
      JMP I    SHLSM
      CIA
      DCA      EAETP2
      TAD      EAETP1
SHLLP,  SWP      /GET LSH
      CLL RAL  /ROTATE 1 BIT LEFT
      SWP      /GET MSH
      RAL      /ROTATE 1 BIT LEFT
      ISZ      EAETP2  /DONE?
      JMP      SHLLP
      JMP I    SHLSM  /YES - RETURN
LSRSM,  0
      DCA      EAETP1  /SAVE AC
      TAD I    LSRSM  /GET NUMBER OF SHIFTS
      ISZ      LSRSM
      SZA      /NO SHIFTS?
      JMP      .+3
      TAD      EAETP1  /RESTORE AC
      JMP I    LSRSM
      CIA      /COMPLIMENT
      DCA      EAETP2
      TAD      EAETP1  /RESTORE AC
LSRLP,  CLL RAR  /ROTATE MSH 1 BIT
      SWP      /GET LSH
      RAR      /ROTATE
      SWP
      ISZ      EAETP2  /DONE?
      JMP      LSRLP  /NO
      JMP I    LSRSM  >

```

/SIMPLT.

PAL8-V7

PAGE 12

IFZERO PLIST <XLIST>

/RESET IF SKIPPING PLOTTER LISTING.

//

5400 PAGE

```

      5400 *5400
05400 0000 SMOOTH, 0
05401 7201 CLA IAC
05402 3107 DCA XMIN /SET FOR NO SMOOTHING
05403 1106 TAD DX
05404 7041 CIA
05405 1150 TAD NSMOOT /FIRST TIME IN?
05406 7640 SZA CLA
05407 5212 JMP NOTINT /NO
05410 1354 TAD SMTHBX
05411 3351 DCA ASMTH
05412 1106 NOTINT, TAD DX /BUFFER FULL ALREADY?
05413 7650 SNA CLA
05414 5223 JMP FLSMTH /YES
05415 2351 ISZ ASMTH /NO
05416 2351 ISZ ASMTH /UPDATE ADDRESS
05417 4340 JMS CVLSMT
05420 2106 ISZ DX /NOOW IS IT FULL?
05421 5600 JMP I SMOOTH /NO
05422 5247 JMP SMTHIT /YES
05423 7305 FLSMTH, CLA CLL IAC RAL /BEGIN PUSH UP ROUTINE
05424 1354 TAD SMTHBX
05425 3237 DCA UPPRSM
05426 7305 CLA CLL IAC RAL
05427 1237 TAD UPPRSM
05430 3235 DCA LOWRSM
05431 7001 IAC
05432 1150 TAD NSMOOT /NUMBER TO MIVE
05433 3355 DCA P54T1
05434 7663 PUSHUP, DLD
05435 0000 LOWRSM, 0
05436 7445 DST
05437 0000 UPPRSM, 0
05440 2235 ISZ LOWRSM
05441 2235 ISZ LOWRSM
05442 2237 ISZ UPPRSM /UPDATE ADDRESS
05443 2237 ISZ UPPRSM
05444 2355 ISZ P54T1 /DONE?
05445 5234 JMP PUSHUP /NO
05446 4340 JMS CVLSMT /YES - INSERT CURRENT VALUE
05447 1150 SMTHIT, TAD NSMOOT
05450 3355 DCA P54T1
05451 1360 TAD COEFX /START ADDRESS OF COEFFICIENTS
05452 3361 DCA COEFSM
05453 7621 CAM
05454 7445 DST
05455 5563 TOTAL /SET TOTAL TO 0
05456 7305 CLA CLL IAC RAL
05457 1354 TAD SMTHBX
05460 3275 DCA P54T2
05461 3107 DCA XMIN /SET SMOOTHING DONE FLAG
05462 7240 SMTHLP, CLA CMA
05463 3356 DCA SIGN /SET FOR + COEF.
05464 3357 DCA ROTAT
05465 1761 TAD I COEFSM /CHECK FOR - COEF.

```

05466	7500	SMA		
05467	5273	JMP	. +4	
05470	7041	CIA		
05471	3356	DCA	SIGN	
05472	1356	TAD	SIGN	
05473	3366	DCA	MLPLR	
05474	7663	DLD		
05475	0000	P54T2, 0		/GET POINT
05476	7450	SNA		/DOUBLE PRECISION?
05477	5304	JMP	. +5	
05500	7417	LSR		/YES - SHIFT RIGHT
05501	0001	1		
05502	2357	ISZ	ROTAT	
05503	5276	JMP	. -5	
05504	1357	TAD	ROTAT	
05505	3311	DCA	. +4	
05506	7405	MUY		
05507	5566	MLPLR		
05510	7413	SHL		/MULTIPLY AND SHIFT LEFT
05511	0000	0		
05512	2356	ISZ	SIGN	
05513	7575	DCM		/COMPLIMENT
05514	7443	DAD		
05515	5563	TOTAL		/ADD TO TOTAL
05516	7445	DST		
05517	5563	TOTAL		/STORE TOTAL
05520	2361	ISZ	COEFSM	/UPDATE
05521	2275	ISZ	P54T2	/ADDRESSES
05522	2275	ISZ	P54T2	
05523	2355	ISZ	P54T1	/DONE?
05524	5262	JMP	SMTHLP	/NO
05525	7621	CAM		
05526	1061	TAD	SPCADD	
05527	3335	DCA	. +6	
05530	7663	DLD		
05531	5563	TOTAL		
05532	4762	JMS I	NORMLX	
05533	5561	COEFSM		/COEFSM CONTAINS ADDRESS
05534	7445	DST		
05535	0000	0		
05536	7621	CAM		
05537	5600	JMP I	SMOOTH	
05540	0000	CVLSMT, 0		
05541	7621	CAM		
05542	1061	TAD	SPCADD	
05543	3345	DCA	. +2	
05544	7663	DLD		
05545	0000	0		
05546	7510	SPA		
05547	5765	JMP I	EREFX3	
05550	7445	DST		
05551	0000	ASMTH, 0		
05552	7621	CAM		
05553	5740	JMP I	CVLSMT	
05554	5776	SMTHBX, 5776		

/SIMPLT.

PAL0-V7

PAGE 16-2

05555 0000 P54T1, 0
05556 0000 SIGN, 0
05557 0000 ROTAT, 0
05560 6221 COEFX, SVTGLY
05561 0000 COEFM, 0
05562 5600 NORMLX, NORMLZ
05563 0000 TOTAL, 0
05564 0000 0
05565 2430 EREFX3, EOREOF
05566 0000 MLPLR, 0
//
5600 PAGE

```

05600 5600 *5600
05601 0000 NORMLZ, 0
05602 7500 SMA
05603 5206 JMP .+4
05604 7621 CAM
05605 2200 ISZ NORMLZ
05606 5600 JMP I NORMLZ
05607 3243 DCA P56T1
05608 3245 DCA RTAT2 /STORE MSH AND SET 0 ROTATION
05609 1600 TAD I NORMLZ /ADD. OF ADD. OF DIVISOR
05610 3236 DCA DVSOR
05611 2200 ISZ NORMLZ /RETURN ADDRESS
05612 1636 TAD I DVSOR
05613 3236 DCA DVSOR
05614 1636 TAD I DVSOR
05615 7041 CIA
05616 3244 DCA P56T2 /COMPLIMENT
05617 1243 TAD P56T1 /MSH
05618 1244 TAD P56T2 /OVERFLOW?
05619 7710 SPA CLA
05620 5232 JMP .+7 /NO
05621 1243 TAD P56T1 /YES
05622 7417 LSK /ROTATE RIGHT
05623 0001 1
05624 2245 ISZ RTAT2
05625 3243 DCA P56T1
05626 5220 JMP .-11
05627 1245 TAD RTAT2
05628 3241 DCA .+6 /SET FOR RE-ROTATION
05629 1243 TAD P56T1
05630 7407 DVI
05631 0000 DVSOR, 0
05632 7200 CLA
05633 7413 SHL
05634 0000 0
05635 5600 JMP I NORMLZ
05636 0000 P56T1, 0
05637 0000 P56T2, 0
05638 0000 RTAT2, 0
05639 0000 IFZERO PLIST (XLIST) /RESET IF SKIPPING PLOTTER LISTING.

```

	6240	*6240	
06240	7765	SVTGLY,	-13
06241	0000		0
06242	0011		11
06243	0020		20
06244	0025		25
06245	0030		30
06246	0031		31
06247	0030		30
06250	0025		25
06251	0020		20
06252	0011		11
06253	0000		0
06254	7765		-13
06255	0217		217
	7510	*7510	
07510	0000	ZBLOCK	41

ABK2TH 2460	A244 2176	DVI 7407	LC3 4624
ABSYRG 0037	BGCHK 2246	DVSOR 5636	LC4 4706
ACHLCD 4377	BGINT 0055	DX 0106	LETTER 4607
ACHLCU 0075	BLBL 0030	EAE 0001	LIFTPN 3167
ACHRCD 0076	BLNKFL 3406	ENDFIL 2461	LINE 6221
ACHTLF 0073	BF20T2 2674	ENDPS1 2472	LINEFD 3563
ACHTRT 0074	BUMP 4467	EOBLK1 2553	LJ 0104
ACRDN 0071	BX 0115	EOBLOK 2551	LK 0107
ACRUP 0072	BY 0116	EOREOF 2430	LL 0103
ADDLTR 2743	CAM 7621	EREFX1 2331	LN 0110
ADDSSP 3262	CCMA 4646	EREFX2 2667	LOCHK 2267
ADFDAD 4767	CDMASS 0144	EREFX3 5565	LOOPSD 3213
ADIMOV 0077	CHLCDN 6121	EREFX4 3166	LOWCHC 2263
ADLTR 0124	CHLCP1 6206	EXECX 2573	LOWRSM 5435
ADMULT 0122	CHLCUP 6200	FACT 0102	LSR 7417
ADNEWB 0123	CHLC1 6127	FLSHIT 2550	LTADR 4707
ADPFTC 0120	CHRCDN 6207	FLSMTH 5423	LTHLD 4717
ADPL0T 0117	CHRC1 6215	FLUSH 3133	LTSTOR 2734
ADPLTW 4375	CHTLFT 6103	FNDADR 4455	LTSWT1 4710
ADRTAT 0125	CHTL1 6111	FNDPLT 2057	LTSWT2 4713
ADSBAL 0121	CHTRT 6112	FRSFLG 0044	LT0 4622
ADTBL 4505	CHTR1 6120	FRSNZR 2227	LT1 4626
AEBLK1 2332	CIAC 4541	GCMND 4534	LT2 4637
AEBLK2 2673	CMND 4423	GMOVE 4523	LT3 4671
AHDRPL 0040	CNT 4522	GOTONE 3270	LT4 4677
AINPL 0022	CNTR 4507	HAX 5670	LWINT 0057
ALFTPN 2575	COEFSM 5561	HAY 5671	LXADDR 0105
ALINE 0020	COEFX 5560	HBX 4536	LYADDR 0106
ALPHA 4400	COMPAR 4347	HBV 4537	MASK2 3561
AMNMXP 2167	CONVT 3551	HDRPLT 3277	MASNUM 0050
AMSADD 0042	CPEN1 6217	HDRT1 3333	MBLBL 0147
AMTHOU 3272	CRDN 6065	HDRT2 3347	MCRTRN 3562
APENDN 0070	CRDN1 6073	HLD 4434	MES1 2340
APENUP 0067	CRSTAC 6220	HVMAS 0045	MES2 2343
APL 0021	CRTCHK 3455	ICHPOT 3267	MHUN 2740
APLOTW 0143	CRTMAS 0051	IMCAND 5666	MLPLR 5566
APLTIT 2333	CRUP 6074	IMOVE 5646	MOVE2 4716
APRSC1 2365	CRUP1 6102	INCLP2 2651	MRA 7701
APRSC2 2742	CURNT 3273	INCRLP 2314	MQL 7421
AP20T1 2574	CVLSMT 5540	INCRSP 3255	MRBOUT 3557
AP20T2 2335	CYCL 4473	INIB 4440	MSDTNX 2172
ARGC1 2427	DAD 7443	INLP5D 3214	MSMTCH 0046
ARGC2 2672	DCAX 4436	INORM 3612	MTHOU 3263
ARTORG 0041	DCM 7575	INORM1 3627	MULT 4510
ASMTN 5551	DECCAR 3271	INPL 3400	MUY 7405
ASPTCD 2744	DLD 7663	INTCRT 2670	M1 4765
ASRER1 2334	DLTA 4521	INTRD 3075	M10 0023
ASTMSP 0141	DLTR 4600	INTRVL 0047	M2 0135
ASTORG 0032	DLTRX 3354	IX 0111	M201 2572
ATRON 0066	DONECK 2301	IY 0112	M3 0136
AX 0113	DPMASS 3566	JMPLT4 4712	M4 0134
AXMSCL 2356	DPMT 3577	JMSAM 4711	M40 2170
AXPLT 0064	DPSZ 7451	KPTRAC 3274	M40P30 3145
AY 0114	DST 7445	LC1 4670	M400 4502
AYPLT 0063	DTIC 0110	LC2 4642	M46 2741

M5	2567	PLOTT2	4333	RSTFLG	2533	SPRD	5240
M5Q	4503	PLOTT3	4336	RTAT2	5645	SQ	5104
M6300	2571	PLOTWT	6032	RTNORG	3027	SR	5112
M77	0130	PLOTX	4200	RTNRG1	3045	SRCIT	3152
NCNT	4437	PLOTZ	4561	R180	4740	SRPR	5216
NEWB	4446	PLOT1	4227	R270	4752	SRVEY1	2400
NIAC	5673	PLOT2	4263	R90	4730	SRVEY2	2405
NOMSCR	2117	PLOT3	4304	S	0105	SS	5120
NOMSC1	2126	PLOT4	4326	SADDR	0103	SSCL	5343
NONZRO	3236	PLTMAS	2676	SAPS	5214	SSPC	5156
NORMLX	5562	PLTNUM	2723	SB	5005	ST	5127
NORMLZ	5600	PLTSTP	2600	SC	5014	STLDOT	2513
NOTINT	5412	PLTST1	2610	SCBX	5157	STORIT	3240
NPTS	0054	PLTWT	6130	SCDM	5210	SU	5132
NPTS1	2336	PLTWTA	6216	SCEX	5204	SUBALF	4542
NPTS2	2426	PRESRC	3146	SCOC	5164	SUB1	4544
NPTS3	2666	PRN1CH	3510	SCOL	5335	SURVEY	2235
NSMOOT	0150	PROTHD	3313	SCOM	5232	SV	5136
NUMB	0103	PRTOUT	3531	SCPL	5177	SVTGLY	6240
N11	0132	PSOC40	3275	SCTR	5173	SW	5140
N144	0133	PTMASC	0142	SD	5021	SWAB	7431
N40	4504	PUSHUP	5434	SDSH	5236	SWP	7521
N5	0131	P106	3560	SE	5025	SX	5143
N7	4714	P1205	2350	SECNDC	3250	SY	5146
N70	4715	P20	3335	SEQU	5354	SZ	5151
N77	0127	P20T1	2165	SETFLG	2157	S0	5244
OCTNUM	3261	P20T2	2166	SETMSP	2351	S1	5252
OPENRX	0033	P200	3332	SETORG	3111	S2	5255
ORGNUM	0034	P2066	3334	SF	5031	S3	5262
OUTPUT	0126	P22T1	2337	SG	5035	S4	5271
PADDR	4435	P237	0146	SGRT	5357	S5	5274
PASS	0043	P240	3564	SH	5043	S6	5302
PCKLN	3417	P26T1	2675	SHFCNT	3647	S7	5311
PENDN	6056	P273	2570	SHFCN2	3650	S8	5315
PENUD	0065	P277	3565	SHFTIT	3600	S9	5326
PENUP	6042	P40	0031	SHL	7413	TABLE	5000
PEN1	6050	P5	2737	SI	5047	TADDR	4506
PEN2	6051	P54T1	5555	SIGN	5556	THETA	0104
PEN3	6064	P54T2	5475	SJ	5053	TMP	4766
PFETCH	4406	P56T1	5643	SK	5057	TMP1	0024
PL	3517	P56T2	5644	SL	5063	TMP2	0025
PLCHQ	2617	P6	3353	SLPR	5222	TMP3	0026
PLIST	0000	P60	3276	SLST	5352	TMP4	0027
PLOTA	4220	P6300	0052	SM	5065	TM361	3646
PLOTDB	4317	P707	2566	SMOOTH	5400	TOTAL	5563
PLOTDX	4372	RADD	0171	SMTHBX	5554	TRADD	0035
PLOTDY	4373	RDHDRX	2171	SMTHIT	5447	TRNON	2357
PLOTHD	3336	RDHEDR	3060	SMTHLP	5462	T3612	3651
PLOTMY	4376	RDINTX	0053	SMTHX	0151	UPHBYT	3326
PLOTNA	4374	READX	0137	SN	5070	UPOUT	3545
PLOTNX	4370	RESET	0062	SO	5073	UPPRIN	3503
PLOTNY	4371	RGCPLT	3000	SP	5100	UPPRSM	5437
PLOTON	2364	ROTAT	5557	SPCADD	0061	WAITX	0140
PLOTPN	4367	ROTATE	4720	SPLS	5227	X	0100
PLOTT1	4330	RSTAC	6052	SPOCTD	3200	XHD	3344

/SIMPLT.

PAL8-V7

PAGE 19-2

XMIN 0107
XMSCLR 2731
XRG 3007
Y 0101
YHD 3345
YMSCLR 2732
YRG 3010
YTOBPL 2636
Z2000 2355

END
DATE
FILMED
7-24-74
NTIS